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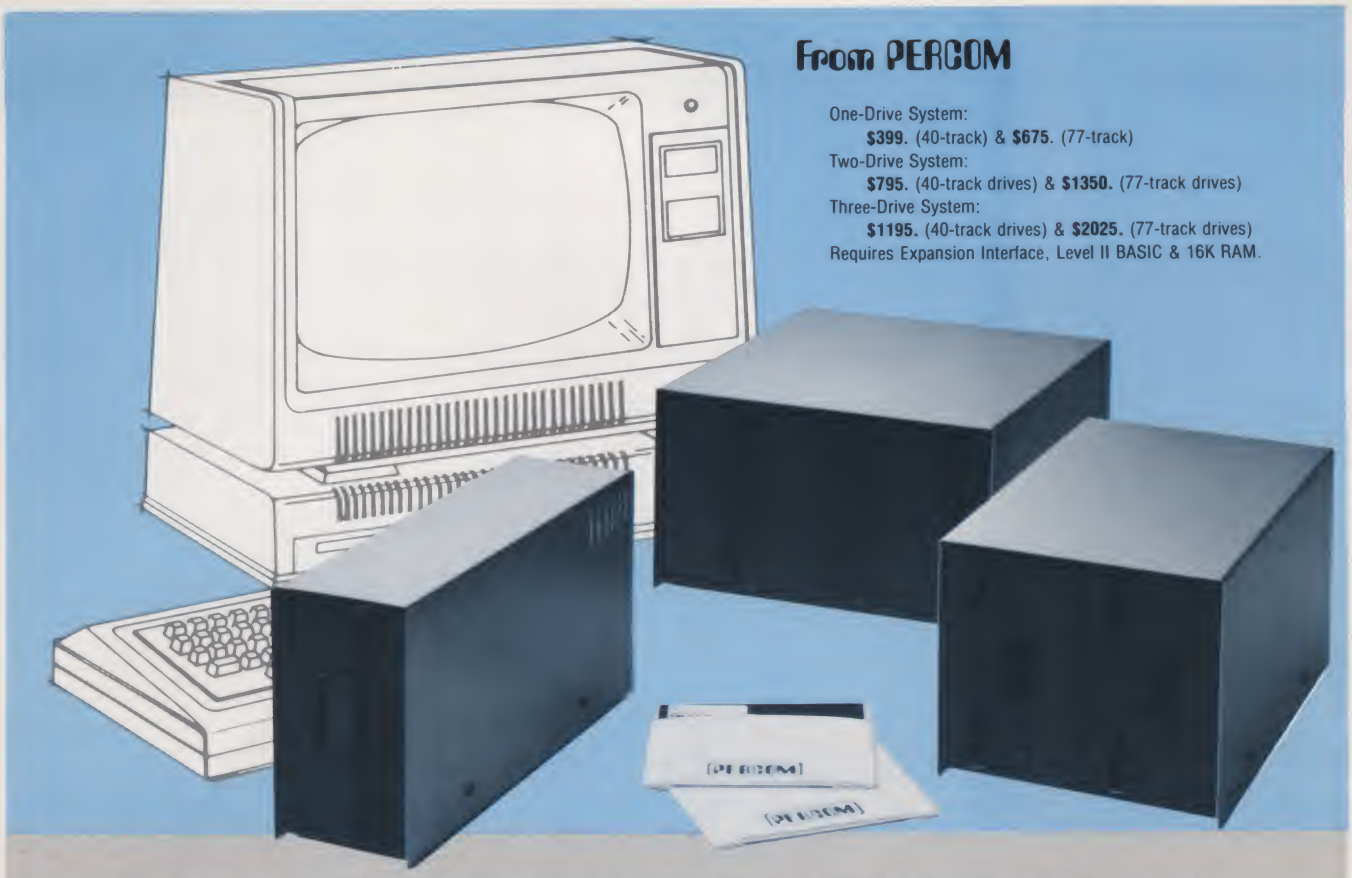
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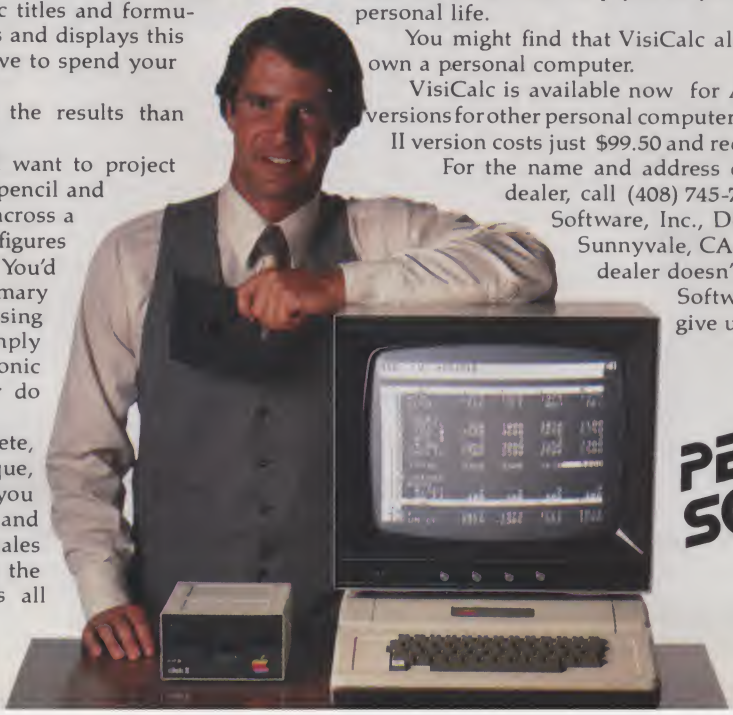
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Cover: This month's cover shows the Exatron Stringy Floppy (ESF) in use as the mass-storage subsystem for the SWTP microcomputer. The ESF fills the gap between the standard cassette and the floppy disk. For less than the cost of the latter, the ESF provides comparable reliability and eliminates the aggravation of slow operating speeds and high error rates of most cassette systems. For more information on the ESF see pages 15 and 98.

micro info

$ This symbol next to a title in the table of contents indicates that the article is a business-application article.

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PUBLISHER'S REMARKS

Wayne Green

Like to Make $20,000 A Month?

Yes, I know: It sounds interesting if the work isn't too hard and the hours not too long.

There is a need, I feel, for the development of manufacturers' representatives in the microcomputing industry. I was making some calculations of what a rep might be able to earn to see if the field is attractive enough to bring people into this business. The figures look good.

Let's say we divide the country into about 20 areas. With about 1000 computer stores currently in business, this would allocate about 50 stores per area. This is probably all one rep could handle without hiring assistants, since he is going to have to get around to most of these stores at least once a month.

What would the rep do? Well, if we take as an example a rep for Instant Software, he would check the display in a store, make sure it is well placed, make sure it is well stocked, that all the newest releases are prominent, that our posters are on display, that store clerks know how to demonstrate the new programs, answer any questions on programs from clerks, replace any troublesome programs, report to the factory on sales, on any problems, on good vibes and anything else of value to the factory.

As the library of programs increases, a rep is going to have his hands full keeping stores in stock and keeping records of sales, making sure the billing is correct and that stores stay on time with payments. This isn't much of a problem when there are only 100 programs, but Instant Software is aiming at supporting a library of several thousand business, scientific, educational, game and home programs. Every store will have a program library, which will be a large part of their business, probably accounting for much more sales and profit than hardware.

But let's say that our rep is handling just 50 stores, that there are only 500 programs so far released (one year from now at the latest), that the average retail price of the programs is about $15 ($8 for games, $15 for educational programs and $100 for business) and that each store sells an average of . . . how many? Two per month? Three? Five? Ten? Let's take two, so we'll be sure to be underestimating in every way. I think there will be more like 500 stores in each area within a couple years. I'll be disappointed if Instant Software does not have 1000 programs released by mid-1980. But taking the low-ball estimate of 500 programs, two average per month per store, we come up with retail sales per store per month totaling $15,000. Fifty stores will make $750,000 in sales for the rep in his area. A rep would thus get a 10 percent commission on wholesale . . . or about $45,000 per month commissions.

If it turns out that there are 10,000 stores instead of 1000 selling computers, multiply the above figure by 10. If we have twice or three times the number of programs released, double or triple that number. If I'm wrong and sales are only one tenth of my estimate that is still $4500 a *month* in commissions per rep.

If I'm near right in my projections, we're going to have a bunch of millionaire reps.

Stores won't be doing badly either. At the low figure of $15,000 sales per month, their profit will run about $6000! A library of 5000 programs would bring in around $60,000 in *profit* per month!

So how can one get into this lucrative rep business? This is not for the lazy. It means working hard seven days a week for a long time building up the business. It means having a car so you can get to all of the dealers . . . and eventually a van or even truck for delivering programs and promotion materials. One should have a familiarity with microcomputers, with selling, with bookkeeping, with software, plus the determination to succeed.

It will take some time to develop a reputation and to build up commissions. Of the 50 stores in an area, probably no more than five or ten are already stocking Instant Software . . . the rest will have to be sold. There will be resistance . . . there always is to something new, no matter how beneficial it is. Some dealers won't want to carry software for the TRS-80 because they aren't selling it. This means you'll have to show them how this will bring more customers into their store and permit them to take advantage of the rapidly growing and highly lucrative market in accessories for the TRS. It means showing the dealer that most newcomers to computing are coming in via their purchase of a TRS or other small system rather than as a hobbyist, as it was a couple years ago.

But even with five dealers and only 100 program packages and with the average retail price at $8, a rep can right now, without growth, make nearly $500 per month in commissions. Each extra store brought on line should increase the monthly commissions by a minimum of $160.

If we add in the 2300 Radio Shack associate stores and franchise stores, all of which have the freedom to deal directly with Instant Software through a rep firm, we're adding about 115 more stores per rep area . . . right now. Can you sell TRS programs to Radio Shack stores? If you can't, then you sure should stay in some other business. Better go get a degree as an engineer and not have to work again.

Paris Micro/Expo

Sybex's micro show in Paris was well attended, with some very familiar names exhibiting. Here are some more photos of people and exhibits at the show.

Software Support Critical

Several of the smaller manufacturers of microcomputer systems haven't thought very far ahead and as a result are not aware of the importance of software to their sales when the time comes that other systems have a large supply of inexpensive software.

Let's exaggerate just a trifle to get the concept. Let's suppose that a prospective microcomputer customer has been lured into a store and is looking over system A vs system B. One has the support of several thousand programs—some right down his alley for business, some just a help in his business, plus some games, security, data base, word processing, etc., which look good. The other system has no programs available at all. The price on the two systems is similar. Which do you think he will buy?



Here is the Heath exhibit. Actually, the interest in kits seemed to be less than expected, so the new Heath line of assembled units will probably better fit the European temperament. Europeans don't seem to be interested to a high degree in the hobby aspect of microcomputers, but rather in using them for practical business and scientific applications.



One of the most crowded booths all through the show was the Tandy booth. The TRS-80 is a best seller in some parts of Europe, and just getting started in others.



Sybex did a brisk business in their books, some of which have now been translated into German and French.



Reinhard Nedela and Sherry were busy at the Kilobaud Microcomputing *booth with subscriptions and Instant Software sales.*

Actually, the prices of the two systems will not be similar because the software support of one system will so increase its sales that there will be substantial cost reductions to pass along to the customer . . . and to the dealer in terms of higher profits. A doubling of production in this field seems to result in a dropping of manufacturing costs of about 25 percent. This can mean a drop of about four times that to the customer.

Unfortunately for the systems manufacturer who does not push hard for software support, the more software developed for another system, the more will be developed. It is self-generating. And the more software there is, the better all of it is going to be. Instant Software is getting much more selective about the software being accepted for publication. With some dismay, we are already seeing our rejects coming on the market from smaller publishers, and we know that disappointment is ahead for the people who get suckered into buying these programs, which are usually published at a higher price than the better programs ISI is publishing.

The growth of software publishing has been held back to some degree by the costs of lab hardware. The more money that has to be put into hardware, the less is available for salaries and the people needed to get the work done. Manufacturers may eventually recognize this and work out some system for helping software publishers with their work . . . and with equipment.

Business Software

The development of top-notch business software for microcomputers is, as I predicted, taking a lot longer than games . . . and for obvious reasons for anyone who gives it any thought. It takes a lot of time, experience and genius to write really good business programs; plus you have to have both the hardware available and the language and operating system before you can get a good start.

Much of the business software now coming into Instant Software for publication has been developed by individual programmers for custom applications . . . often in conjunction with a local Radio Shack store. Some of these programs are indicative of what we can expect in the future—programs, for instance, for specific hospital functions, for working with blood testing systems to speed up their operation and print out the results of hundreds of tests, to work with patient monitoring equipment to keep a record of many factors and alert someone if anything gets out of acceptable parameters, to determine the doses of certain medicines from tests by other equipment.

We'll be seeing this depth of business software developing in many fields. We've already some surprisingly sophisticated real



Bob Jones of Interface Age *had a booth too. The airlines lost his luggage for a couple of days, making the first part of the visit a bit hectic.*



Though Harold Buchbinder, the publisher of Personal Computing *was scheduled to talk, he never showed up, and the PC booth was vacant.*

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estate packages, but they are nothing to what we'll have in a year or two when most brokers will not only have immediate information on their inventory, but also data on all neighboring inventories and a wide range of calculations possible on the myriad of methods for financing real estate. The forms will be done automatically, along with all billing, title search and legal aspects.

I had to laugh at the innocence of one manufacturer who thinks of microcomputer business software as a "bad joke . . . written by amateurs." I hope he keeps his non-micro business going . . . he may need it. Many of the programs we are seeing are being written by old-time professional programmers, some with PhDs in computer science. Being a PhD doesn't mean you are stupid and don't know where the money is, and the big money for the freelance computerist lies in software—business software right now, then educational, and finally all kinds. Computers can handle just about any timesaving application once the programs are available. I will again predict that the eventual uses for our microcomputers will surprise all of us. The surface is just being scratched and, as new programs are developed, the need for more will follow.

As a publisher, I can look forward to word processing helping prepare material for publication. Computers can then be used to lay out pages and set them ready for printing, even to making the printing plates directly. Editors can use a computerized index to list published material for fast referencing. Computerized soliciting of bids for printing and paper will provide efficiencies and cut costs. Computerized mail will speed material for publication from remote writers and editors. Computers can help with determining the imposition of pages on a larger press. Computers help work out the best ratio of advertising to editorial material, taking into consideration the number and placement of two-color ads, three-color ads, four-color ads and editorial material with color.

Then we need computers to take care of daily orders from individuals for current and back issues. Computers can also handle orders from dealers and wholesalers. Computers will speed up shipping and billing, bookkeeping, handling plastic money, keeping an inventory record and sales records of all transactions. These, in turn, will provide reports for the circulation people so they know which ads are working best and what covers sell better than others. Add in the replies to various polls, and you have more need for computers to provide a better product at a lower price.

The microcomputer will be able to help every business to operate at lower cost and with more efficiency. Plus it will take a lot of the drudgery out of the work by doing most of the routine. I think we will be seeing all of these programs evolving for microcomputers, and I'm hoping that Instant Software will be the major distributor of these programs . . . all over the world.

In May we opened up Europe for software distribution. South Africa should be next in September. Asia will be opened up in October. The more outlets for software there are, the more royalties for the programmers . . . and the better programs we'll have to help sell systems. Will systems with poor software support sell? I can't think of any reason they should.

New Apple!

Though I've seen no releases yet from Apple, the stores are now selling a new model, the Apple II+. We'll probably hear more about the changes involved, but the immediate difference has to do with the BASIC ROM, which comes built in.

The Apple II came with Integer BASIC installed, and you had to add Applesoft via a plug-in board to get floating point numbers, high-resolution routines and a much more complete BASIC. The Apple II+ system has the Applesoft built in, and you have to plug in an Integer BASIC card to run your programs written in that version . . . or to speed up some functions. Delivery is expected soon on the Integer BASIC boards.

The Instant Software Apple programs—Golf (0018A), Bowling (0040A), Math I (0073A), Math II (0098A)—are mostly in Applesoft. Trilogy (0040A) and a second run of Math I (0040A) are in Integer BASIC. Apple owners not having both languages should be careful when buying packaged programs and make sure they match the ROM they're using.

Ripped Off?

If you have a serious problem with a microcomputer firm, send them a letter with *all* the facts in detail, plainly and simply, and send a copy to me. *Kilobaud Microcomputing* protects its readers more than any other magazine.

OUTPUT FROM ISI

Sherry Smythe

The number of programs available for microcomputers is growing slowly; most of the new entries still are games. Dealers are not enthusiastic about this. They prefer to see business-oriented software since these programs will not only provide program sales, but also will help to sell their systems.

Oddly enough, one of the best business programs released (Business Cycle Analysis, a powerful management tool) so far has been for the TRS-80, and Radio Shack stores are prohibited from selling programs other than those released from Ft. Worth. This may be costing stores thousands of computer sales and costing Radio Shack into the millions. Meanwhile, computer stores are enjoying the bonanza, and TRS-80 owners are forced to find their neighborhood computer store to get any serious support for their system.

Many dealers have been reluctant to stock programs for systems other than those they are selling. The dealers who are stocking programs for all systems are finding that their program sales are substantially better as a result. Perhaps 85 percent of the newcomers to microcomputing these days are entering via a TRS-80, and stores with no TRS-80 products are effectively chasing away their best sales prospects.

Prospects for business programs are better and better. About half the programs now being submitted for publication by Instant Software are business-oriented. Oh, the umpteenth financing program arrived long ago and aroused as much interest as another version of Hangman or Mastermind. When you consider how many business programs there are to be written, you wonder at this reinventing of the wheel. Many programmers are now getting together with business friends and developing program packages for them for mass publication.

The crew at Instant Software has been growing. The programs are now all cataloged on a TRS-80 with a couple disks, as are the associate editors and their specialties. There is more and more work for associate editors as more programs are being translated for use on more systems and also into foreign languages . . . in addition to the usual evaluations of newly submitted programs.

Disks

Increasing numbers of programs are being submitted on disks, which is fine with us. There is little reason for a business, even a small business, not to invest in at least a dual-disk system. Without that minimum of on-tap memory, few significant programs can be used. Should the day come when it seems better to sell a program on a disk, Instant Software will go that route. In the meantime, most programs—even the disk-based programs—are easily transportable via cassettes, and this saves some money.

We're geared up to check out and produce programs based on NEWDOS, which is getting very good marks from users. Judging from reader reports, it appears to be superior to TRSDOS.

Educational Programs

Games are *not* needed. Programs already listed as available are not badly needed. Educational programs are very much in demand. But look here—if you are going to write a program to teach

(see OUTPUT, page 190)

BOOK REVIEWS

The Cheap Video Cookbook
Don Lancaster
Howard W. Sams & Co., Inc.
Indianapolis IN
1978, 256 pp., paperback

All of us at one time or another have probably yearned for a video terminal. Some of us were rich enough to afford one, but the rest of us had to be content to struggle with our eight puny data LEDs until the day came when we could afford a good terminal for our own. Well, that day has arrived. Don Lancaster has come to our rescue with his latest "cookbook," *The Cheap Video Cookbook*, which explains in detail how you can design and build your own terminal for less than $20!

The big secret behind cheap video is that there is relatively little hardware used—a handful of gates and a character generator. The key to the system is the microprocessor. Utilizing several routines in conjunction with a video interface, the microprocessor does all the "housework" such as generating the video and sync signals. By changing your software structure, you can change your terminal's characteristics. As a result, you can have a very simple terminal or a very versatile one with almost any feature you could want. Features include: any display format from 1 × 16 to 24 × 80; various character fonts from 5 × 7 dot matrix to Old English; 256 × 256 black and white graphics; 96 × 128 color graphics; a host of control features such as scrolling and reversed video.

The important thing to notice is that no matter how advanced a terminal you want, the price you pay for an extra option is not another fancy IC, but rather another portion of your memory. And you don't need much memory either; 1K will keep you busy for quite a while.

While the video system described in this book has a lot going for it (low cost and versatility), it also has a few disadvantages. The most serious one, perhaps, is that it will not readily work with many CPUs. The CPU must meet certain demands if the video interface is to function properly. One requirement is that the microprocessor be able to advance the program counter once every microsecond. It must also have 16 always-present and fully decoded address lines. Some systems just cannot meet these requirements without additional hardware, which means more $$$.

Since the video interface described in the book was designed for 6500- and 6800-based systems, computers with such chips as the F-8, SC/MP, 1802 and even the 8080 will require modification to be compatible. Depending on the system, these modifications could be extensive and difficult. Not only that, but the software will have to be translated as well. In short, conversion to another CPU will introduce new problems and take your creative talents to solve.

Since the video system in this book is based around the 650x microprocessors, it is necessary that you be familiar with the 6500 machines as well as the KIM-1. The author recommends that prior to this book you read the following: *The TV Typewriter Cookbook* (Sams 21313); *An Introduction to Microcomputers*, Volumes I & II (Osborne 2001 and 3001, respectively); user's manuals for the 6500 and KIM-1; user's manuals for your system.

Obviously, *The Cheap Video Cookbook* is not intended for the beginning hobbyist.

The Cheap Video Cookbook contains five chapters. Chapter 1 deals with the foundations of cheap video, how it works, what it can do and which CPU to use. Two new and very important concepts are also introduced: the Scan Microinstruction and the Upstream Tap.

Chapter 2 shows how to design the software for the cheap video system. Here we discover how to build programs for the scan microinstruction, alphanumeric displays, high-resolution graphics and full-performance cursors. Editors and graphics loaders are also described in detail. Incidentally, owners of KIM-1 systems will be able to use these programs right out of the book.

Chapter 3 involves the design of the video interface. The circuit is designed step-by-step from the instruction decoding PROMs to the output circuitry. Finally, you are shown how to interface the system with a KIM-1 and how to add a video input to an ordinary TV set.

Chapter 4 is like an instruction booklet for the many electronic kits produced these days. The first part of this chapter discusses circuit theory and the construction of Don Lancaster's latest TVT, the TVT 6-5/8. All components are installed one by one, and each step is checked off after completion. There are also several excellent full-size patterns for the PC boards and solder mask. In addition, chapter 4 contains complete construction details for four additional add-on modules that give the TVT 6-5/8 extra features such as graphics (black and white and color) and lowercase alphanumerics. With the TVT 6-5/8 and each module is a troubleshooting guide to help isolate errors in construction and programming. The chapter winds down with information concerning modifications and part of a chess program utilizing the color-graphics module.

The principles of transparency, which allow the CPU to compute data and run the video interface simultaneously, are discussed in chapter 5. Several methods are shown along with the 6500 software required to make them work.

Four appendices finish the book. Appendix A is simply a listing of the ASCII code, while appendix B is an octal-hex-decimal conversion chart (rather handy!). Appendix C contains the pin-outs of several ICs used throughout the circuits described in this book. Appendix D repeats the PC board patterns scattered in chapter 4.

Overall, the book appealed to me. The material is presented in a clear, easy-to-understand manner (provided, of course, you have the necessary background material previously mentioned) and can be mastered in a fairly short time. My biggest complaint is that the software and most of the hardware is designed primarily for the 6500 series CPUs.

Although I believe that every computer system can be adapted to use cheap video techniques in some way, I don't recommend this book to anyone who doesn't own a 6500 or 6800 microcomputer. However, if you do own another type of system and are sincerely interested in a $20 video terminal, and you are willing to put much time and effort into it, then I suggest you either borrow a copy or read the first chapter in the bookstore before you purchase the book. That way you can determine if cheap video is for you without unnecessarily investing money that would have been better spent on some more RAM or even another book. If you opt for the latter method, I suggest you hide behind a bookshelf to avoid evil looks from the shopkeeper!

Steve Dominguez
Golden CO

Programming in PASCAL
Peter Grogono
Addison-Wesley, Inc.
1978, $10.95

If you've been wondering what all the hoopla about PASCAL is then this is the book for you. Since you'll probably be seeing a lot of PASCAL anyway, what with the Apple II, TRS-80 and other versions coming out, you may as well buy the book now and save yourself some time later.

You can probably already tell that I like this book. As a matter of fact, I can't say enough good things about it. If we'd had textbooks like this when I was in school, we wouldn't have needed teachers. Grogono takes you by the hand and leads you through the very most fundamental concepts of programming through the most powerful features of PASCAL. The text is liberally illustrated with actual programs and easy-to-understand syntax diagrams (finally—easy-to-read syntax diagrams!) that make learning the language a snap.

Chapter 1, an introduction to computer programming, includes a discussion of what a program is and a short introduction to PASCAL to help you get your feet wet. I have a strong feeling that even a non-programmer can learn to write PASCAL programs with no help but this book. Chapter 1 is part of the reason for this.

Chapters 2, 3 and 4 cover much of the language. With these first four chapters under your belt you'll be ready to try some programs of your own. The clarity of the book and the well-chosen examples should make these about a weekend's worth of reading even for a total beginner.

Chapter 5 covers some of the functions PASCAL performs,

(see REVIEWS, page 14)

OHIO SCIENTIFIC'S ⌐013
SMALL SYSTEMS JOURNAL

Introduction

Our objective in this issue is to give the reader brief descriptions of two systems included in the OS-DMS grouping—General Ledger and Payroll—which have not yet been shown in our previous articles. Several of the reports created by these systems will be shown in order that the reader might better understand the purposes of the systems.

OS-DMS General Ledger System

In the normal office environment there is a need to keep track of how much business is done by the firm. Whether the amounts earned are normal or not and whether the company is making a profitable return on its investments are samples of questions constantly posed about a business. The figures utilized to answer these questions are measurements of money, and the process of working with these figures is called accounting. The most basic accounting report used in the process of keeping track of a firm's activities is the general ledger, and any specific series of operations designed to reveal the financial status of a firm is called a general ledger system.

A general ledger system may be manual or automated. It may be very simple for a small firm or extremely complex for a large corporation with multiple divisions or departments. In all cases, however, the basic objectives of having a general ledger are the same: enable management to know how the firm is faring financially as well as make decisions and forecasts from an informed position.

The OS-DMS General Ledger System is designed to fit into this office environment in the following manner.

Cash is earned or borrowed, spent or loaned, and in other ways comes and goes. This cash flow should be carefully controlled. This is the objective of the cash receipts and disbursements portion of this system. All incoming and outgoing funds are entered in detail on the computer through the console terminal in a clerical operation. The payer or payee name, the date, a reference number of some type, a general ledger account number and the dollar amount of each activity are put into the computer as the transactions take place. An input journal of the events that take place in this operation is printed so that the person overseeing the cash flow (the manager) may review the activities when the need arises. Periodically, cash receipts journals and cash disbursements journals are printed in order to have records of the cash activities of the firm. At the ends of accounting periods, totals from each general ledger account affected by the cash flow from the period are posted to the general ledger, and the cash books for that period are closed.

While cash transactions make up a large activity area in business, many accounting entries do not include a movement of funds. Buildings and equipment must be depreciated. Items are bought and sold for promises to pay. Taxes and other expenses are accrued through a certain date. All these entries must appear in the company's books.

In this general ledger system, these types of transactions are entered separately from the cash movements. The routine through which these entries are made prints the general journal, a normal accounting entry ledger. Through this general journal, records are maintained as to what activity has gone on at what time.

The data entry is constant in both the cash and non-cash areas. The end of an accounting period is a point at which the entries for one measurable time period—usually a month or a year—are stopped so that their contents may be worked with, totaled, compared to other like periods and evaluated. This is the closing of the books. Reports such as the general ledger, the operating statement and the balance sheet are printed for middle and upper management's needs. Data is stored for historical reference and analysis. Management personnel now have reports concerning a standard time period in a common format with which they may make decisions that affect the future of the firm.

This system produces all the reports mentioned above. It also takes care of expansion or restructure of the general ledger system. Protection of the data through disk backup is an integral part of this operation.

The OS-DMS general ledger is open-ended. Though this system is large, and in itself is complete, it is just a part of the needed product for most users. Through the use of the various other modules and the nucleus utilities of OS-DMS, there is much that may be done to expand its capabilities. Every user's needs are different, so this is a necessary state. It is felt that the base provided here can support this expansion.

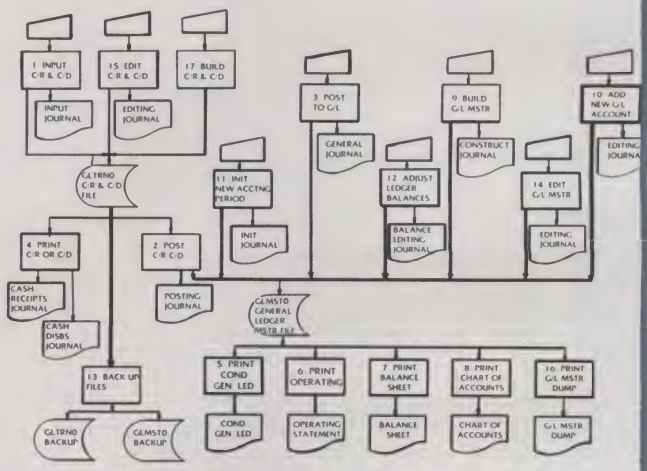


FIGURE 1. OS-DMS GENERAL LEDGER LOGIC FLOW DIAGRAM

The first area we shall look at is the input function. This general ledger system has two specific input routines—one to handle cash receipts and disbursements and the other to work with all other types of entries. The main difference between the two is that the former creates a detailed transaction file of all entries, whereas the latter posts directly to the general ledger master file. Sample input journals are as follows:

```
CASH RECEIPTS OR DISBURSEMENTS INPUT JOURNAL          01/26/79        9:25
==========================================================================
  PAYER/PAYEE                 DATE        REF #      ACCT #      AMOUNT
STARTING NEW ACCOUNTING PERIOD.
SUBTOTAL: 0.00
--------------------------
ADD RECORDS
... CASH RECEIPTS ...
  JOHNSON BAKERY              01/03/79    203756     1020        250.00
  SMITH LUMBER CO             01/05/79    33398      4010        159.90
  APEX STORES INC             01/10/79    12205      1020        500.00
  CONSOLIDATED TRUST          01/10/79    330856     4010        3579.55
  JACKSON DRUGS               01/12/79    222556     1020        300.00
  W & W CAFETERIA             01/15/79    330564     1020        325.50
  CITY FINANCE CO             01/17/79    440322     4010        1399.50
SUBTOTAL: 6514.51
--------------------------
ADD RECORDS
... CASH DISBURSEMENTS ...
  FIRST NATIONAL BANK         01/10/79    44032      2015        115.00
  WILLIAMS EQUIPMENT          01/12/79    22034      5010        304.79
  ACME INSURANCE CO           01/15/79    33944      5250        157.00
  OFFICE PAYROLL              01/15/79    22045      5410        3022.50
SUBTOTAL: 3599.29
--------------------------
... END RUN ...
```

FIGURE 2. CASH RECEIPTS OR DISBURSEMENTS INPUT JOURNAL

GENERAL JOURNAL 1/23/79 9:46

DATE	ACCT	NAME/DESCRIPTION	REF NUMBER	DEBITS	CREDITS
1/10/79	1030	JOHNSON EQUIPMENT	33085	2579.40	
1/10/79	2010	ACCOUNTS PAYABLE	33085		2579.40
1/10/79	1040	HAYES OFFICE SUPS	33057	13.78	
1/10/79	2010	ACCOUNTS PAYABLE	33057		13.78
1/13/79	1330	GLOVER SUPPLY CO	33058	308.00	
1/13/79	2010	ACCOUNTS PAYABLE	33058		308.00
1/16/79	4010	ALLIED STORES	55098	4500.00	
1/16/79	1020	ACCOUNTS RECEIV.	55098		4500.00
1/16/79	1020	55098 CORRECTION	55098-C	4500.00	
1/16/79	4010	55098 CORRECTION	55098-C		4500.00
1/18/79	1030	ALLIED STORES	55098	4500.00	
1/18/79	4010	SALES	55098		4500.00
TOTALS:				16401.18	16401.18
NET:				0.00	

FIGURE 3. INPUT GENERAL JOURNAL

In addition to the printouts from these input runs, we should also look at the end-of-period statements. The first of these is the balance sheet, and the standard OS-DMS format is as follows:

BALANCE SHEET
FOR PERIOD ENDING 9/30/78

	ASSETS		
CURRENT ASSETS			
CASH	8591.99		
ACCOUNTS RECEIVABLE	6572.76		
INVENTORY	4502.78		
PETTY CASH	753.83		
TOTAL CURR ASSETS		20421.36	
FIXED ASSETS			
LAND	12301.38		
BUILDINGS	51348.55		
DEPRECIATION—BUILDINGS	-9417.67		
EQUIPMENT	10753.20		
DEPRECIATION—EQUIPMENT	-4301.75		
TOTAL FIXED ASSETS		60683.71	
OTHER ASSETS			
PREPAID DEPOSITS	528.56		
TOTAL OTHER ASSETS		528.56	
TOTAL ASSETS			81633.63
LIABILITIES			
CURRENT LIABILITIES			
ACCOUNTS PAYABLE	3419.82		
DIVIDENDS PAYABLE	4106.09		
INCOME TAX PAYABLE	1821.69		
INTEREST PAYABLE	532.43		
INSURANCE PAYABLE	378.66		
TOTAL CURR LIABILITIES		10258.69	
LONG-TERM LIABILITIES			
LONG-TERM NOTE	9721.45		
TOTAL LONG-TERM LIABS		9721.45	
OTHER LIABILITIES			
PREPAID SERVICES	2670.18		
TOTAL OTHER LIABILITIES		2670.18	
TOTAL LIABILITIES			22650.32
STOCKHOLDERS' EQUITY			
COMMON STOCK	40000.00		
RETAINED EARNINGS	18983.31		
TOTAL STKHOLDERS' EQUITY			58983.31
TOT LIABILITIES & EQUITY			81633.63

FIGURE 4. BALANCE SHEET

Along with the balance sheet, the other primary end-of-period report is the operating statement, often referred to as a profit and loss statement. The standard OS-DMS operating statement has the following format:

OPERATING STATEMENT
FOR PERIOD ENDING 9/30/78

DESCRIPTION	CURR AMOUNT	% CURR SLS	YTD AMOUNT	% YTD SLS
REVENUES				
SALES	18509.10	101.06	167705.43	101.29
SALES RETURNS	194.35	1.06	2142.56	1.29
NET SALES	18314.75	100.00	165562.87	100.00
COST OF SALES				
BEGINNING INVENTORY	1508.30	8.24	2503.48	1.51
ADD: PURCHASES	10210.44	55.75	103750.54	62.67
DED: PURCH RETS & ALLOWS	820.75	4.48	9331.25	5.64
TOTAL GOOD AVAIL	12539.49	68.47	115585.27	69.81
DEDUCT: ENDING INVENTORY	4502.78	24.59	4502.78	2.72
TOTAL COST OF SALES	8036.71	43.88	111082.49	67.09
GROSS PROFIT	10278.04	56.12	54480.38	32.91
OPERATING EXPENSES				
SALES EXPENSES				
SALES SALARIES	2053.69	11.21	19858.55	11.99
ADVERTISING	359.98	1.97	3476.18	2.10
TOTAL SALES EXPENSES	2413.67	13.18	23334.73	14.09
GENERAL EXPENSES				
SALARIES	684.30	3.74	6615.50	4.00
RENT	152.55	.83	1476.21	.89
TELEPHONE	392.23	2.14	4070.63	2.46
TOTAL GENERAL EXPENSES	1229.08	6.71	12162.34	7.35
TOTAL OPERATING EXPENSES	3642.75	19.89	35497.07	21.44
NET PROFIT—LOSS	6635.29	36.23	18983.31	11.47

FIGURE 5. OPERATING STATEMENT

Other reports necessary for the smooth operation of a general ledger system are the utility reports. Included in this category are printouts such as a chart of accounts and a formatted master file listing. In the OS-DMS system, these two reports appear as follows:

CHART OF ACCOUNTS 9/30/78

ACCT #	DESCRIPTION	TYPE RCD	DEBIT/CREDIT
	ASSETS		
	CURRENT ASSETS		
1020	CASH	ASSET	DEBIT
1030	ACCOUNTS RECEIV	ASSET	DEBIT
1040	INVENTORY	ASSET	DEBIT
1050	PETTY CASH	ASSET	DEBIT
	TOTAL CURR ASSETS	MINOR TOTAL	
	FIXED ASSETS		
1510	LAND	ASSET	DEBIT
1520	BUILDINGS	ASSET	DEBIT
1530	DEPRE—BUILDINGS	ASSET	CREDIT
1540	EQUIPMENT	ASSET	DEBIT
1550	DEPRE—EQUIPMENT	ASSET	CREDIT
	TOTAL FIXED ASSETS	MINOR TOTAL	
	OTHER ASSETS		
1810	PREPAID DEPOSITS	ASSET	DEBIT
	TOTAL OTHER ASSETS	MINOR TOTAL	
	TOTAL ASSETS	MAJOR TOTAL	
	LIABILITIES		
	CURRENT LIABILITIES		
2020	ACCOUNTS PAYABLE	LIABILITY	CREDIT
2030	DIVIDENDS PAYABLE	LIABILITY	CREDIT
2040	INCOME TAX PAY	LIABILITY	CREDIT
2050	INTEREST PAYABLE	LIABILITY	CREDIT
2060	INSURANCE PAYABLE	LIABILITY	CREDIT

FIGURE 6. PORTION OF CHART OF ACCOUNTS

OS-DMS GENERAL LEDGER MASTER FILE LISTING 9/30/78

ACCT #	DESCRIPTION	PREV BAL	TRNSACTNS
1000	ASSETS		
1010	CURRENT ASSETS		
1020	CASH	6270.46	2321.53
1030	ACCOUNTS RECEIVABLE	7191.22	-618.46
1040	INVENTORY	2503.48	1508.30
1050	PETTY CASH	778.40	-24.57
1499	TOTAL CURR ASSETS		
1500	FIXED ASSETS		
1510	LAND	12301.38	0.00
1520	BUILDINGS	51348.55	0.00
1530	DEPRECIATION—BUILDINGS	-8692.23	-725.44
1540	EQUIPMENT	10753.20	0.00
1550	DEPRECIATION—EQUIPMENT	-3980.66	-321.09
1799	TOTAL FIXED ASSETS		
1800	OTHER ASSETS		
1810	PREPAID DEPOSITS	507.21	21.35

CURR BAL	RCD TYPE	DEBIT/CREDIT	SOURCE	OPEN 1	OPEN 2
	H (HEADER)				
	H (HEADER)				
8591.99	A (ASSET)	D	3W	0	CASH
6572.76	A (ASSET)	D	4E	0	A/R
4502.78	A (ASSET)	D	25	0	INV
753.83	A (ASSET)	D	7T	0	0
	3 (MINOR TOT)				
	H (HEADER)				
12301.38	A (ASSET)	D	M	0	0
51348.55	A (ASSET)	D	M	0	0
-9417.67	A (ASSET)	C	M	0	0
10753.20	A (ASSET)	D	M	0	0
-4301.75	A (ASSET)	C	M	0	0
	3 (MINOR TOT)				
	H (HEADER)				
528.56	A (ASSET)	D	M	0	0

FIGURE 7. PART OF GENERAL LEDGER MASTER FILE LISTING

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✓ Reader Service—see page 227

In addition to the reports shown above, of course, there is some form of printed documentation created by practically every operation performed within the system. This is designed to assist the user in recording his actions, but even more, to allow him to see where he has skipped an operation. In all cases, the objective of the system has been to assist the user in the management of his firm and give him better control.

OS-DMS Personnel/Payroll System

Payroll is a normal part of any business that employs more than one person. In order to comply with various laws, an employer must maintain records of each payroll run made for the firm. In response to this need, Ohio Scientific has developed the Personnel/Payroll System under OS-DMS.

The programs in this computerized system allow the operator to perform three basic personnel functions. The first is to compile and maintain an accurate employee data file, the second is to generate reports from this data, and the third is to run payroll.

The various primary options available in this system are as follows:

```
PERSONNEL AND PAYROLL SYSTEM
----------------------------
(1) INSTRUCTIONS
(2) EMPLOYEE EARNINGS REPORT
(3) CHECK FILE REPORTS
(4) PAYROLL FOR ALL ACTIVE EMPLOYEES
(5) PAYROLL FOR INDIVIDUAL EMPLOYEES
(6) EDIT PAYROLL INFORMATION
(7) EDIT EMPLOYEE INFORMATION
(8) EDIT CHECK FILE INFORMATION
(9) SORT PAYROLL INFORMATION
(10) SORT EMPLOYEE INFORMATION
(99) EXIT
```

FIGURE 8. PERSONNEL/PAYROLL MENU

From the menu above, the various options available to the operator may be described as follows:

Option 1 presents to the operator a series of instructions as to how to run the system properly.

Options 2 through 5 are covered in detail following this explanation. Options 6 through 10 are file maintenance operations used to put new employees on the file, change the information in their records when needed and sort their records in various sequences as the occasions warrant. These runs, while not the producers of the end product, are used with regularity to maintain the various files. Options 4 and 5 perform the same operations with one primary difference: the payroll run for an individual does not update the computer files. When an out-of-cycle check is run for an employee, then the editing programs should later be used to enter the data into his records.

The sequence of operations for all payroll runs starts with the presentation to the operator of the run options. These are shown on the monitor screen and set the pattern for the entire run. Following this, the entries for the individual employees are made. The computer gets these through a dialogue with the operator as shown below.

```
EMPLOYEE NAME     ALCORN ALAN
EMPLOYEE NUMBER   0                    WAGE EMPLOYEE
    << NO COMMISSIONS >>
REGULAR HOURS WORKED ? 80
OVERTIME HOURS WORKED ? 2. 3
OTHER PAY ? 123. 11
```

FIGURE 9. EMPLOYEE HOURS ENTRY

With the information now known, the calculations of the individual's payroll figures are made and the following display of the results is made on the monitor screen:

```
EMPLOYEE NAME: ALCORN ALAN
EMPLOYEE NUMBER: 0                                  WAGE EMPLOYEE

REGULAR PAY:      400.00
OVERTIME PAY:      17.25
COMMISSION:         0.00
OTHER PAY:        123.22          GROSS PAY:        540.47
DEDUCTIONS
 FICA                                33.13
 FEDERAL INCOME TAX                  79.51
 STATE INCOME TAX                     6.01
 LOCAL TAX                            5.40
 INSURANCE                            7.50
                          GROSS DEDUCTIONS        131.55
                                   NET PAY        408.92

IS THIS CORRECT ? N
  (1) EARNINGS CHANGE (COMPLETE CHANGE)
  (2) DEDUCTION CHANGE
  (3) SKIP THIS PERSON
? 2
```

FIGURE 10. EMPLOYEE PAYROLL CALCULATIONS VERIFICATION

If the employee deduction change is desired, the following series of questions and answers takes place between the operator and the computer.

```
                POSSIBLE DEDUCTIONS
1 FICA                  2 FEDERAL INCOME TAX
3 STATE INCOME TAX      4 LOCAL TAX
5 INSURANCE             6 OTHER DEDUCTIONS
                SELECT DEDUCTIONS
FICA
  IS THIS DEDUCTION TO BE USED ?
FEDERAL INCOME TAX
  IS THIS DEDUCTION TO BE USED ?
STATE INCOME TAX
  IS THIS DEDUCTION TO BE USED ? N
LOCAL TAX
  IS THIS DEDUCTION TO BE USED ? N
INSURANCE
  IS THIS DEDUCTION TO BE USED ? N
OTHER DEDUCTIONS
  IS THIS DEDUCTION TO BE USED ? Y
ENTER THE AMOUNT OF THE EMPLOYEE DEDUCTION ? 50.00
```

FIGURE 11. EMPLOYEE DEDUCTION CHANGE

At the end of the run the totals for the entire payroll run are made. These are needed fo several reasons, most importantly to insure that the amount of money being paid out known and can be deposited in the payroll bank account to cover the checks being issue

```
PAYROLL FOR 7/3/79          TODAYS DATE: 7/20/79          PAGE: 1
-------------------------------------------------------------------
TOTAL NUMBER OF EMPLOYEES PAID 4
AVERAGE OVERTIME HOURS 1.86
TOTAL REGULAR PAY      1749.35
TOTAL OVERTIME PAY       51.74
TOTAL COMMISSIONS         0.00
TOTAL OTHER PAY           0.00
                                  TOTAL GROSS PAY     1001.09
TOTAL FICA              110.40
TOTAL FEDERAL           228.58
TOTAL STATE              15.97
TOTAL LOCAL              18.02
TOTAL INSURANCE          37.50
TOTAL OTHER DEDUC         0.00
                                  TOTAL DEDUCTIONS     410.47
                                  TOTAL NET PAY       1390.62
-------------------------------------------------------------------
```

FIGURE 12. PAYROLL SUMMARY

When all the entries have been made and the totals printed, the check stubs may be printe for the employees. A variation of this run is to have the computer print the actual checks but since check designs vary significantly from company to company, the actual chec printing program is not included as a part of the system.

For filing purposes, the payroll register is printed and is then available for historical use

```
CHECK FILE REPORT FOR THE 7/3/79 PAYROLL   TODAY'S DATE: 7/29/79   PAGE:
-------------------------------------------------------------------
OHIO SCIENTIFIC    7/3/79                OHIO SCIENTIFIC    7/3/79
NAME: ALCORN ALAN                        NAME: BEACHLY JERRY

REGULAR HRS.      73.75                  REGULAR HRS.      80.00
OVERTIME HRS.      2.50                  OVERTIME HRS.       .32
 PAY RATE          5.00                   PAY RATE          3.75

REGULAR PAY:     368.75                  REGULAR PAY:     300.00
OVERTIME PAY:     18.75                  OVERTIME PAY:      1.80
COMMISSIONS:       0.00                  COMMISSIONS        0.00
OTHER PAY:         0.00                  OTHER PAY:         0.00
 GROSS PAY               387.50           GROSS PAY                301.80
-------------------------------------------------------------------
DEDUCTIONS                               DEDUCTIONS
FICA:             23.75                  FICA:             18.50
FEDERAL:          48.33                  FEDERAL:          32.90
STATE:             2.95                  STATE:             2.05
LOCAL:             3.88                  LOCAL:             3.02
INSURANCE:         7.50                  INSURANCE:         0.00
MISC:              0.00                  MISC:              0.00
-------------------------------------------------------------------
TOTAL DEDUCTIONS          86.41          TOTAL DEDUCTIONS         56.47
NET PAY                  301.09          NET PAY                  245.33
-------------------------------------------------------------------
```

OHIO SCIENTIFIC 7/3/79
NAME: CALOWAY JOHN

REGULAR HRS.	80.00	
OVERTIME HRS.	0.00	
PAY RATE	733.83	
REGULAR PAY:	733.83	
OVERTIME PAY:	0.00	
COMMISSIONS:	0.00	
OTHER PAY:	0.00	
GROSS PAY		733.83
DEDUCTIONS		
FICA:	44.98	
FEDERAL:	87.90	
STATE:	8.15	
LOCAL:	7.34	
INSURANCE:	22.50	
MISC:	0.00	
TOTAL DEDUCTIONS		170.87
NET PAY		562.96

FIGURE 13. CHECK STUBS

HECK FILE REPORT FOR THE 7/3/79 PAYROLL TODAY'S DATE: 7/29/79 PAGE: 1

AME: ALCORN ALAN
REG HRS: 73.75 REG PAY: 368.75 FICA: 23.75
OVT HRS: 2.5 OVT PAY: 18.75 FEDERAL: 48.33
COM PAY: 0 STATE: 2.95
AY RATE: 5 OTHER PAY: 0 LOCAL: 3.88
INSURANCE: 7.5
OTHER: 0
GROSS PAY: 387.50 GROSS DEDUC: 86.41 NET PAY: 301.09

AME: BEACHLY JERRY
REG HRS: 80 REG PAY: 300 FICA: 18.5
OVT HRS: .32 OVT PAY: 1.8 FEDERAL: 32.9
COM PAY: 0 STATE: 2.05
AY RATE: 3.75 OTHER PAY: 0 LOCAL: 3.02
INSURANCE: 0
OTHER: 0
GROSS PAY: 301.80 GROSS DEDUC: 56.47 NET PAY: 245.33

AME:CALOWAY JOHN
REG HRS: 80 REG PAY: 733.83 FICA: 44.98
OVT HRS: 0 OVT PAY: 0 FEDERAL: 87.9
COM PAY: 0 STATE: 8.15
AY RATE: 733.83 OTHER PAY: 0 LOCAL: 7.34
INSURANCE: 22.5
OTHER: 0
GROSS PAY: 733.83 GROSS DEDUC: 170.87 NET PAY: 562.96

AME: SMITH SANDY
REG HRS: 77.06 REG PAY: 346.77 FICA: 23.17
OVT HRS: 4.62 OVT PAY: 31.19 FEDERAL: 59.45
COM PAY: 0 STATE: 2.82
AY RATE: 4.5 OTHER PAY: 0 LOCAL: 3.78
INSURANCE: 7.5
OTHER: 0
GROSS PAY: 377.96 GROSS DEDUC: 96.72 NET PAY: 281.24

GURE 14. PAYROLL REGISTER

nother format used for saving and filing the information is that used for the earnings and eductions summaries. If there are few types of earnings and deductions, these two may be ombined as a single report.

AYROLL SUMMARY FOR 7/3/79 TODAY'S DATE: 7/29/79 PAGE: 1

AME	REG HRS	OVT HRS	PAY RATE	REG PAY	OVT PAY	COM	OTHER
LCORN ALAN	73.75	2.5	5	368.75	18.75	0	0
EACHLY JERRY	80	.32	3.75	300	1.8	0	0
ALOWAY JOHN	80	0	733.83	733.83	0	0	0
MITH SANDY	77.06	4.62	4.5	346.77	31.19	0	0

AYROLL SUMMARY FOR 7/3/79 TODAY'S DATE: 7/29/79 PAGE: 2

AME	FICA	FEDERAL	STATE	LOCAL	INSURANCE	OTHER
LCORN ALAN	23.75	48.33	2.95	3.88	7.5	0
EACHLY JERRY	18.5	32.9	2.05	3.02	0	0
ALOWAY JOHN	44.98	87.9	8.15	7.34	22.5	0
MITH SANDY	23.17	59.45	2.82	3.78	7.5	0

GURE 15. EARNINGS AND DEDUCTIONS SUMMARIES

When ends of reporting periods pass, various reports are required for numerous governmental agencies as well as the firm's own needs. To provide the data necessary for the production of these reports, the employee earnings record is often used. This report prints all payroll information about a given employee or about all employees for whatever payroll or group of payrolls is specified at the start of the program. It is formatted as follows:

NAME: JOHN DOE
ADDRESS: 1234 SOUTH LAKE STREET
KENT, OH 44240
PHONE: 898-1121

PERIOD ENDING	REG HRS	OVT HRS	TOTAL HRS	PAY RATE	REG PAY	OVT PAY
1/2/79	57.00	0.00	57.00	0.00	456.00	0.00
1/16/79	87.75	0.00	87.75	8.00	702.00	0.00
1/30/79	73.00	0.00	73.00	8.00	584.00	0.00
2/13/79	82.00	0.00	82.00	8.00	656.00	0.00
2/27/79	86.50	0.00	86.50	8.00	692.00	0.00
3/13/79	88.50	0.00	88.50	8.00	708.00	0.00
3/27/79	70.00	0.00	70.00	8.00	560.00	0.00
4/10/79	76.50	0.00	76.50	8.00	612.00	0.00
4/24/79	85.00	0.00	85.00	8.00	680.00	0.00
5/8/79	83.50	0.00	83.50	8.00	668.00	0.00
5/22/79	86.50	0.00	86.50	8.00	692.00	0.00
6/5/79	129.25	0.00	129.25	8.00	1034.00	0.00
6/19/79	80.00	0.00	80.00	8.40	672.00	0.00
7/3/79	86.00	0.00	86.00	8.40	722.40	0.00

TOTALS FOR THE PERIOD

REG. HRS.:	1171.50	REG. PAY:	9438.40
OVT HRS:	0.00	OVT. PAY:	0.00
		COM. PAY:	0.00
		OTHER PAY:	466.02

GROSS PAY: 9904.42

EMPLOYEE EARNING RECORD
SOCIAL SECURITY NUMBER: 111-12-2222

DATE HIRED: 1/4/74
DATE TERMINATED:
OCCUPATION: ASSEMBLER
MARITAL STATUS: SINGLE
ALLOWANCES: 1

OTHER PAY	GROSS PAY	FICA W.T.	FED W.T.	STATE W.T.	LOCAL W.T.	OTHER W.T.	GROSS DEDUC	NET PAY
0.00	456.00	27.59	70.35	3.82	4.56	0.00	106.32	349.68
114.54	816.54	50.05	181.65	12.19	8.17	0.00	252.06	564.48
0.00	584.00	35.80	102.97	6.38	5.84	0.00	150.99	433.01
59.29	715.29	43.85	143.05	9.56	7.15	7.50	211.11	504.18
0.00	692.00	42.42	134.70	8.98	6.92	7.50	200.52	491.48
107.81	815.81	50.01	176.46	12.17	8.16	7.50	254.30	561.51
0.00	560.00	34.33	96.08	5.90	5.60	0.00	141.91	418.09
0.00	612.00	37.52	110.70	6.98	6.12	7.50	168.82	443.18
89.18	769.18	47.15	160.60	10.91	7.69	7.50	233.85	535.33
0.00	668.00	40.95	127.50	8.38	6.68	7.50	191.01	476.99
14.71	706.71	43.32	139.37	9.35	7.07	7.50	206.61	500.10
0.00	1034.00	63.38	255.70	12.90	10.34	7.50	349.82	684.18
80.49	752.49	46.13	154.93	10.49	7.52	7.50	226.57	525.92
0.00	722.40	44.28	144.70	9.74	7.22	7.50	213.44	508.96

FICA W.T.:	606.78
FEDERAL W.T.:	1998.76
STATE W.T.:	127.75
LOCAL W.T.:	99.04
OTHER W.T.:	75.00

GROSS DEDUCTIONS: 2907.33 NET PAY: 6997.09

FIGURE 16. EMPLOYEE EARNINGS RECORD

The next issue will conclude our series of articles on OS-DMS with a discussion of the new Educational Testing System, Quotation/Estimation System and the enhanced Inventory System including order entry, inventory explosion and forecasting.

OHIO SCIENTIFIC 1333 S. Chillicothe Road • Aurora, Ohio 44202 • (216) 562-3101

REVIEWS

(from page 9)

such as CASE statement, scalars, subranges and sets. Chapter 6 introduces arrays and records; chapter 7 presents files. Titled "Dynamic Data Structures," chapter 8 covers pointers and linked lists in one of the most lucid treatments I've ever seen. Chapter 9 finishes up the language with the GOTO statement and some discussion of dynamic memory allocation.

As soon as you have some grasp of the language, you can read chapter 10, which covers program design. This is handy for the beginner who may not have any idea at all how to go about developing, testing and debugging a program. For the non-programmer who wants to learn how, this chapter alone is worth the price of the book. Appendix D, "Program Standards," should be read along with this chapter for a good understanding of what makes a program a good or bad piece of work.

A section of the book simply titled "Further Reading," with no chapter or appendix number, is a boon to somebody like me who knew absolutely nothing about PASCAL before he picked up this book. This section contains a good PASCAL bibliography along with information on the PASCAL Users' Group. Used in conjunction with your local college library, this section will easily take care of your spare time for about a month.

Appendices A and B cover, in summary, the vocabulary and syntax of PASCAL. The syntax appendix (B) contains all those marvelous syntax diagrams that are spread throughout the text. I've copied mine and have them pinned to the wall in front of my desk for quick reference while I'm still learning PASCAL. Appendix C, the last of the appendices, can be safely ignored unless you happen to be using the CDC implementation of PASCAL. It contains a discussion of the peculiarities of that implementation and is rather interesting, but probably not much use to most readers of the book.

After raving about the book for eight paragraphs I have to register my one complaint. Virtually all the examples in the early part of the book are mathematical. So are the exercises at the end of the chapters. Despite being a computer-science major, I feel that an introductory book like this should make no assumptions about the reader's background. A programming text *not* directed toward embryonic engineers will be welcome. Maybe someday I'll write my own.

William L. Colsher
Lisle IL

Computer Power for the Small Business
Charles J. Sippl, Fred Dahl
Prentice-Hall, Inc.
Englewood Cliffs NJ
1979, $15.95

This book is full of words. Virtually all of them are arranged into grammatically correct sentences. Virtually none of these sentences can convey any useful information to the intended reader, the small businessman.

If we may begin with a summary, this is the worst "technical" book I have ever seen. The writers don't understand the technology they attempt to report on (in much too much detail); they don't understand the requirements for business computing; and there is no way that their intended reader, the small-business "operator" (their term), could get past the flood of meaningless (to him) technical detail to what little good advice the book contains.

To support these contentions, let's look at the authors' reporting of computer technology. "A 12-inch rectangular CRT *usually* displays 32 characters in 8 lines." (Emphasis mine.) Now, they are supposed to be talking about business computers, including micros, but that description fits the crudest of TV games at best. "Usually?"

"The *standard floppy* is 9 inches square." (The italics are theirs this time, saving me the trouble!) If floppies were nine inches on a side they would loose one of their finest attributes: the ability to be shoved into a "standard" file folder in a "standard" file cabinet. It makes me wonder if the authors ever saw a floppy, or a ruler.

While on the subject of floppies, the writers warn the reader to be on the lookout for "preformatted" floppies, which they insist means "hard-sectored." (Just the opposite is the case, of course.) Their warning is ridiculous to begin with, as they claim that preformatting will force the user to adapt his file size to that required by the preformatting. File sizes are, of course, under control of the operating system, and are invariably quite flexible.

I am not trying to nitpick. I want to make it plain that these are only a couple of examples of the abysmal lack of technical expertise displayed by the authors— which makes their poor attempts to explain technology to the naive reader a real imposition on his valuable time and a waste of his $15.95. And they don't know when to quit, roaming far afield from the subject of business computers to discuss everything from microphones to robots, in great detail and with gross inaccuracy.

I never knew that those funny little bar codes on packages in the grocery store are what is known as the "Universal Produce Code." Just try to stick one on a head of lettuce!

Moving on to the subject of the requirements for a business computer, the picture caption on page 77 opens with the statement that "RCA's Cosmac VIP is certainly applicable to business uses . . . ." The photo shows a gentlemen laboriously keying in what appears to be a multiple-page program through the VIP's tiny keypad. Now, the VIP is a fine little machine as far as it goes, and it can be used as an introduction to micros; as the basis on which to build a hobby computer; or as a toy. But a business computer it certainly is not!

The writers just don't seem to know what computing or data storage a business requires. Hence their statement that "a year's worth of records can very likely be contained on—at most—two floppies." Did they ever interview anyone using a computer in business? What research led to this astounding conclusion? A year's worth of records for an entire small business on two floppies? It would seem to be a wonderful dream. Maybe it was.

Similarly detached from reality is the statement, in the context of discussing the smallest ($2000) systems, that software costs "can be as much as half the cost of the hardware." This statement appears to be based on a single example of a system used to control an air-conditioning system—not a business computer as such. It is offered to a reader contemplating the purchase of a business computer as advice on what to expect his software to cost. At best it is a gross underestimate.

It is in the field of business software that the prospective computer user needs the most advice, and the most accurate advice. Unfortunately, this book contains almost none. The chapter on software lists computer *languages* without explaining their features or intended uses. It ignores the subject of application programs, which is of paramount importance to the business user.

In summary, the writers have tried to cover an incredibly bewildering array of technical topics in a book intended to be a guide to selecting a business computer. And they do cover these topics—with an impenetrable rubble of unnecessary definitions and technical inaccuracies, preventing the businessman from finding what little good advice the book does contain. But the silly advice overwhelms the good . . . for instance, the suggestion that the businessman should read such publications as "Digital Design," which is exactly what its name implies, a periodical for digital-design engineers.

One accurate statement that the book does contain is that the book itself (ignoring pictures) "could easily be contained on a single floppy diskette." Perhaps the book *should* be on a floppy. It would make it easier to return it to the seller. And it should be returned, on the grounds that it is not at all what it is advertised to be: "a complete and practical guide" to selecting and using a business computer.

But save the return postage. Don't buy this book.

One final, ironic quote from Sippl and Dahl: "Something is missing in the business computer market: knowledgeability." They provide a prime example of the truth of that statement!

Ken Barbier
Borrego Springs CA

Logic—Home Study Course
Milton Howard Aronson
Measurement & Control
Pittsburgh PA
32 pages, Paperback, $3

If you are in any way mixed up with computers or logic devices, you probably should have this course. The course is actually a "home study" article reprinted from the September-October 1970 issue of the trade magazine *Medical Electronics and Data.* It begins by explaining what logic is and what it does. Assuming no particular background in either

(see REVIEWS, page 108)

ESFOA Newsletter

Secretary, Fred Waters

STRINGY FLOPPY FOR SWTP

This month the newsletter of the Exatron Stringy Floppy Owners Association (ESFOA for short) addresses the SWTP version. in keeping with the theme of this issue.

If you haven't taken a close look at the front cover, do it now. You can see that the Exatron Stringy Floppy is capable of earning a living at the office as well as in the more traditional role as "Keeper of the Games". This exciting new subsystem consists of a controller and up to two transports. Combining the economy of tape with the speed and reliability of the disk, Exatron gives you another choice.

The CONTROLLER is a complete system on a board, comprising a synchronous serial interface, a data encoder, a clock recovery circuit, and the necessary latches for peripheral control. Also on board are EPROMs containing the software drivers. There are four sockets for 2708s; three are used for the basic system software. The EPROMs occupy memory addresses $C000–$CFFF in the standard configuration. However the controller is addressable to any 4K block in memory, and you can order custom EPROMs in any block to fit your system.

UTILITIES firmware consists of the low-level drivers and an I/O package designed to reduce monitor dependency. No calls to a monitor are used: I/O is accomplished by direct manipulation of a serial interface for the console, and a parallel interface for the printer. The console I/O is done through a vector which may be changed after initialization. The board cold-start routine sets the vector at Port 2 if there is nothing at Port 1. The printer is set at Port 7. The utilities program has many useful subroutines which can be used by other programs.

SYSTEMS SUBROUTINES are also contained in the firmware. The command TBAS will load and execute TSC 6800 BASIC, the fastest BASIC running on an 8-bit microcomputer. The command MBAS will load and execute Microsoft BASIC, which has data file capability, as well as compatibility with Microsoft BASICs on other machines. EDIT loads the TSC Text Editor, an excellent line- and content-oriented editor with many local and global commands. ASMB runs the TSC Assembler, a fast mnemonic assembler with object code generation into memory or into a Stringy Floppy.

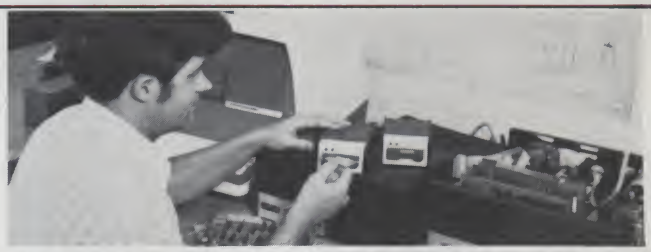
Other system commands include HSAVE, HLOAD, NEWTAPE, and ASN. For a system having one drive, no drive number is specified in the command. If you have a two-drive system, you specify the drive number if the command addresses the drive not designated as the system drive. This designation can be changed using the ASN command. NEWTAPE is the routine for certifying new wafers. A fourth EPROM socket with room for another 1K of memory is available for system expansion.

The TRANSPORT uses state-of-the-art digital and linear techniques. It reads and writes 14,400 bits per second, or optionally 7200 bits per second, with a typical error rate of 1 in 100,000,000 bits. The transport has an average life of over 3500 hours. It has controls for motor on, fast forward, tape mark, wafer present, write protect, and write enable. Power is supplied by the controller.

The WAFER is a high-impact plastic case, about the size of a business card, and 3/16 of an inch thick, enclosing an endless loop of tape. The tape is wound somewhat like that in the familiar 8-track cartridge. Wafers are available with various lengths of tape: 5, 10, 20, and 50 feet. The average life of the wafer is 2500 passes.

PRICES

Cntrlr + Trnsprt	$250.00
Trnsprt only	$124.50
TSC 6800 BASIC	$39.95
Microsoft BASIC	$43.00
TSC Text Editor	$31.00
TSC Assembler	$33.00
Advanced Programmer's Guide	$20.00
Ctrlr, 2 Trspts, Micrsft, & TSC software	$499.95



JIM MAYNARD WORKING ON SOFTWARE FOR THE SS-50 ESF

NOW HEAR THIS! Membership in the ESFOA is automatic when you purchase an Exatron Stringy Floppy. One of the purposes of this Newsletter is to tell you about some of the interesting and useful projects which have been completed by ESFOA members. Jim Maynard, an expert programmer and hardware designer, has spent many many hours during the past year developing the SS-50 version of the ESF. Jim accomplished this monumental task singlehandedly and deserves a big round of applause from all SS-50 computer owners. Jim has some other exciting projects nearing completion.
Many other major software and hardware projects are in the works and will be reported on here in coming issues.

ESF FOR THE TRS-80

Have all of you TRS-80 owners out there seen the first two ESFOA Newsletters? In the August and September issues of Microcomputing? If you didn't, borrow a friend's, or go see your dealer, and read them–they describe the TRS-80 ESF. It's delivered assembled and tested at the factory, and within seconds of connecting it up you are ready to go. If you have any questions about it, or need more information, or want to order one, use our toll-free number. See the ordering information in the box below.

The ESF for the TRS-80 has met with great success. It fills an obvious need, and thousands of the TRS-80 owners were, in effect, looking for the ESF before they even knew of its existence. Disks are still expensive, and are needed when you have to store millions in bytes, but they are not what most personal computer owners are looking for. Audio cassette recorders and playback machines, along with audio-style cassettes, have their shortcomings, and YOU don't need to be told about that. [You should see some of our mail! Extracts from some of the letters, with horror stories and condemnation of cassettes and recorders are actually unprintable!] So ESFs are being shown by their owners with pride to their local TRS-80 Users Groups, and the word has spread.

You don't find many subsystems of this quality with an unconditional 30-day money-back guarantee. And there are none, we believe, with a one-year full warranty. To quote from the Users Manual, the specific purpose of the 30-day money-back guarantee is to ensure that all ESF owners are satisfied ESF owners.

HOW TO ORDER

All versions of the Exatron Stringy Floppy are covered by a 30-day money back guarantee and a one-year full warranty. The ESF is delivered from the factory assembled and tested. Prices for the SWTP version are given complete in the text above. The TRS-80 version is $249.50, which includes Microsoft Level III BASIC. Instant Software on ESF wafers are available at the list price. BUS-EX, the TRS-80 bus extension, is $15 for the 2-for-1 model, and $5 for each added connector. Wafers at 5, 10, 20 and 50 feet are $2.50 each and $20 for 10. Shipping and handling is $3.00 per order. CA residents add tax. Order fast by calling our toll-free number below and giving your Visa or MasterCharge number.

User's Manual and information package is available at no charge. Shipping and handling is $3.00.

If you have any questions about the product, about Exatron, or ESFOA, please call the Hot Line. Address letters to ESFOA, 3557 Ryder St., Santa Clara, CA 95051.

Stringy Floppy is a trademark of Exatron Corporation ✔E48

HOT LINE 800-538-8559

WITHIN CALIFORNIA (408) 737-7111

**Instant Software on ESF wafers are available at the regular HST price*

PET-POURRI

Len Lindsay

Good news at last. Things are looking up at Commodore, and good news seems to be on the horizon. In my last PET-pourri I was a bit hard on Commodore. This was due to a lot of negative comments from other users as well as lack of information from Commodore. Commodore is now trying to remedy all that. Many new people are being hired. Training programs for PET dealers have now been started. With a good training course, PET dealers will now be able to help PET users locally with specific information and assistance. Final versions of the PET printer and dual-floppy manuals are now being polished and should be available soon. I've seen preliminary copies of these, and they are a vast improvement over the preliminary manuals.

Commodore has products that I believe are far superior to the others in the field. The problem is learning how to unleash the hidden power in the PET, printer and floppy. Full potential of the PET is now beginning to be realized. Both the PET printer and floppy include microprocessors as controllers. A complete PET system (computer, printer, floppy) can handle very sophisticated uses. In the future we should see some comprehensive, serious software available.

Some of this software is already being finalized. Commodore has just signed a contract with the author of a fantastic word processor. I saw a preliminary version and was amazed. It was easy to use and had features I thought were only available on dedicated word-processing systems. I should have a copy of it within the week, so next month I should be able to relate more about it.

Commodore Disk

Commodore's 2040 dual-disk unit holds a great deal of potential. The reliability problems with the earliest units have apparently been remedied, and the disk operating system has been improved. The trick is in learning to use the system. The preliminary manual that comes with the disks is not too helpful. The final manual is being completed now and should help a lot. The 2040 disk utilizes the PET's IEEE port and comes set up as device #8. The manual shows how to change this if you need to.

Presently, the 2040 disk works only with the new PETs. Soon Commodore will begin shipping new ROMs for the old PETs; then the 2040 disk will work with the upgraded old PETs. You can only write on the front side of each diskette, which holds about 170K, but you can use the reverse side of the diskette if you carefully cut out a notch on the left side similar to the notch on the right. Beware, however, that even the smallest particle allowed inside may ruin the diskette.

A significant improvement has been made in the Commodore disk operating system. DOS 3.1 is now included with every system. It takes all the drudgery out of operating the floppy. Take errors as an example. In the program mode, your program can have a subroutine to check for errors. The final manual lists routines that do this. In the direct mode, you only need to hit one key, > (greater than), and the error message is displayed on the PET screen.

The new DOS also eliminates the need to type OPEN and PRINT# commands for accessing the disks in direct mode. Now you simply type > followed by whatever you normally would have had to enclose in quotes in a PRINT# statement. Loading a program from disk is now easy. Just type / (slash) followed by the program name. DOS takes over and does all the work for you, including deciding which disk has the program. If you begin with the character ↑ (up arrow) instead of / the program automatically will run once loaded. And remember, the PET can use pattern matching for finding the program. The program Backgammon 3.4 can be loaded and run with the following direct command: ↑B*.

The asterisk tells the PET to load the first program that begins with the characters preceding the asterisk. In this case, PET would load the first program beginning with B. If another program, such as Baseball 2.5, preceded Backgammon 3.4 on the disk you could use: ↑BAC*. Once loaded into memory the program will automatically RUN.

Which Disk for Your PET?

Do you own several PETs, or do you also have an Apple and a TRS-80? If you answered no, then the Nestar dual-drive full-size floppy disk system is not for you. The Nestar Cluster One is ideal for schools. Up to 15 PETs, TRS-80s and Apples can hook up to one Cluster One. Contact Nestar (810 Garland Dr., Palo Alto CA 94303) for the name, address and phone number of your nearest Nestar dealers.

Computhink Disk and News

Most readers probably only have one PET. Two available disk systems, which I have seen work, are worth your consideration. One, of course, is the Commodore disk. The other is from Computhink (3260 Alpine Rd., Menlo Park CA 94025). Computhink's disk system has been out for over a year already. Readers in the East and Midwest should contact New England Electronics (NEECO), 679 Highland Ave., Needham MA 02194, the Computhink distributor for that section of the country. NEECO now has a new disk operating system as well as a dual-density option. Both sides of each diskette may be written on, unless the disk protect notch is covered, then the diskette cannot be written on. With dual density, each diskette can hold about 200K. Presently, the Computhink disk will only work with the old PETs; soon, it should be available for the new PETs as well.

The Computhink disk system is designed to be plugged into Computhink's Expandamem. It utilizes the PET memory expansion port rather than the IEEE port. The system comes with a diskette containing utilities on one side and helpful examples of disk programming on the other. The utilities include: Monitor, Datafile, Diskcopy (to copy a complete diskette from one drive to the other), Random-Format (sets up a direct-access file), DensityCopy (allows a dual-density drive to read a single-density diskette and create a dual-density copy of it) and two memory tests, PageTest and BlockTest. The examples on the other side are very helpful in showing how to use the commands explained in the manual.

Currently, Computhink is shipping dual-density, dual minifloppy drive systems for the PET. By early fall 1979, they should be shipping this configuration with an added bonus: You can read both sides of each diskette without having to take it out and flip it over, thus having four sides of dual-density diskettes on line—or 800K on line.

Computhink offers more than hardware. They also have a PL/M compiler available for their disk system. A BASIC and FORTRAN compiler will be available soon. Also available now is a comprehensive data base. Contact Computhink for details on these.

Computhink Disk Notes

In the short time that I've had the Computhink dual-density disk system I've developed a Menu program, written for the new DOS, that will enable you to load and run any program on either drive by hitting only one key. The program first puts a directory on the screen. Then an index-key character is printed in front of each entry. The program checks which key is hit and goes to the correct location on the screen. It PEEKs at what name is there and assigns it to F$. It then loads and runs F$ from drive D. The program keeps track of which drive the directory came from and allows you to hit one key to see the directory from the other drive. If you modify each of your programs to end by loading Menu, you can have a continual chain taking almost all the work out of running programs.

I'm not a professional programmer. My program is a bit long and can be written in a more condensed form, but the program now includes many remarks and will be helpful in developing your own version.

Disk Software

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```
  0 REM  THIS IS MENU FOR DISK
  1 REM  IT HANDLES UP TO 39 FILES
  2 REM  IT HANDLES ALL CHARACTERS IN
  3 REM  NAMES EVEN SIMPLE REVERSE
  4 REM  FIELD IF THE REVERSE FIELD
  5 REM  IS TURNED OFF WITHIN THE NAME
  6 REM
  7 REM
 10 INPUT "[CLR][ 2 DOWN][ 2 RIGHT]WHICH DRIVE#  [[ 3 LEFT]";D
 20 POKE 525,1:POKE 527,99
 30 $D,D
100 PRINT "[HOME]&&&HIT THE [RVS]KEY[OFF] OF YOUR PROGRAM CHOICE&&&"
110 PRINT "[UP]&&&HIT [RVS]*[OFF][LEFT][DOWN]^[UP] TO STOP - HIT [RVS]>[OFF][DOWN][LEFT]^[UP] FOR DR1
190 M=32888:REM FIRST INDEX LOCATION
195 F=0:REM INITIALIZE END FLAG
197 IK=0:REM INDEX KEY INITIALIZE
200 FOR L=0 TO 19
205 IF F=1 THEN GOSUB 9200:GOTO 290:REM END HAS BEEN FOUND ALREADY
215 IF PEEK(M+L*40+2)=134 THEN F=1:GOTO 290:REM THIS IS THE FREE TRACK LINE
220 POKE M+L*40,L+129:REM THIS IS THE INDEX LETTER
230 POKE M+L*40+1,31:REM THIS IS A "_"
290 NEXT L
294 L=L+1:GOSUB 9200
300 IF F=1 THEN 1000:REM SKIP SECOND COLUMN - ALREADY DONE
305 M=32907:IK=0:REM SECOND COLUMN
310 FOR L=0 TO 5:REM FOR UVWXYZ
320 IF F=1 THEN GOSUB 9200:GOTO 390
330 IF PEEK(M+L*40+2)=134 THEN F=1:GOTO 390
340 POKE M+L*40,L+149:REM THIS IS THE INDEX LETTER
350 POKE M+L*40+1,31:REM THIS IS A "_"
390 NEXT L
400 IF F=1 THEN 1000:REM END FOUND ALREADY
410 FOR L=6 TO 15:REM FOR 0123456789
420 IF F=1 THEN GOSUB 9200:GOTO 490
430 IF PEEK(M+L*40+2)=134 THEN F=1:GOTO 490:REM END FOUND
440 POKE M+L*40,L+170:REM THIS IS THE INDEX NUMBER
450 POKE M+L*40+1,31:REM THIS IS A "_"
490 NEXT L
500 IF F=1 THEN 1000:REM END FOUND ALREADY
510 FOR L=16 TO 18:REM FOR #$%
520 IF F=1 THEN GOSUB 9200:GOTO 590
530 IF PEEK(M+L*40+2)=134 THEN F=1:GOTO 590:REM END FOUND
540 POKE M+L*40,L+147:REM THIS IS THE INDEX CHARACTER
550 POKE M+L*40+1,31:REM THIS IS A "_"
590 NEXT L
1000 GET AA$:IF AA$="" THEN 1000:REM GET CHOICE
1010 IF AA$="*" THEN 9990
1020 IF AA$=">" THEN D=2-D+1:GOTO 20:REM CHANGE DRIVES
1100 A=ASC(AA$)
1200 IF A>64 AND A<85 THEN M=32890:L=A-65:GOTO 1300:REM SKIP 2ND COLUMN
1205 M=32909:REM FOR SECOND COLUMN
1210 IF A>=85 AND A<=90 THEN L=A-65-20:GOTO 1300
1220 IF A>=48 AND A<=57 THEN L=A-42:GOTO 1300:REM FOR0123456789
1230 IF A>=35 AND A<=37 THEN L=A-19:GOTO 1300
1240 PRINT "[HOME][ 3 RIGHT][RVS]PLEASE CHOOSE ONLY AN INDEX LISTED[OFF]"
1250 GOTO 1000
1299 END
1300 F$="":RV=0:REM INITIALIZATION
1305 PRINT "[HOME][ 23 DOWN][ 3 RIGHT]>>>>>>>>>>>>>>[RVS]HERE IT COMES... [OFF]"
1310 FOR K=0 TO 15
1320 FL=PEEK(M+L*40+K):REM VALUE OF CHARACTER
1322 IF FL>128 AND RV=0 THEN GOSUB 9000
1324 IF FL<128 AND RV=1 THEN GOSUB 9500
1326 IF FL>128 AND RV=2 THEN GOTO 9600
1328 IF FL>128 AND RV=1 THEN FL=FL-128
1330 GOSUB 8000:REM CONVERT TO STRING CHARACTER
1390 NEXT K
2000 IF RV THEN GOSUB 9700
2010 $X,D,F$
8000 REM CONVERT PEEK TO CHR$
8002 REM FL IS PEEK VALUE
8004 REM FT IS CONVERTED FOR CHR$
8006 REM F$ IS THE STRING CHARACTER
8010 IF FL>=0 AND FL<=31 THEN FT=FL+64
8020 IF FL=>32 AND FL<=63 THEN FT=FL
8030 IF FL>=64 AND FL<=95 THEN FT=FL+128
8040 IF FL>=96 AND FL<=127 THEN FT=FL+64
8100 IF FL<128 THEN F1$=CHR$(FT):GOTO 8800
8800 REM F1$ IS CHR$ FOR THIS CHARACTER POKE
8810 F$=F$+F1$
8999 RETURN
9000 RV=1:REM REVERSE FOUND
9010 F$=F$+"[RVS]"
9020 FL=FL-128
9099 RETURN
9200 IF IK=1 THEN 9299
9210 IK=1
9215 POKE M+L*40-40,30:REM  ^
9220 POKE M+L*40,137:REM    I
9225 POKE M+L*40+1,142:REM  N
9230 POKE M+L*40+2,132:REM  D
9235 POKE M+L*40+3,133:REM  E
9240 POKE M+L*40+4,152:REM  X
9245 POKE M+L*40+5,160:REM
9250 POKE M+L*40+6,139:REM  K
9255 POKE M+L*40+7,133:REM  E
9260 POKE M+L*40+8,153:REM  Y
9299 RETURN
9500 RV=2:REM REVERSE FOUND AND TURNED OFF
9510 F$=F$+"[OFF]"
9599 RETURN
9600 PRINT "[HOME][ 2 RIGHT][RVS]YOUR FILE NAME IS TOO CONFUSING FOR ME[OFF]"
9610 GOTO 1000
9700 F$=LEFT$(F$,16)
9799 RETURN
9990 PRINT "[HOME][ 21 DOWN]"
9992 POKE 525,9
9994 POKE 527,145:REM UP
9996 FOR Z=528 TO 533:POKE Z,32:NEXT Z:REM SPACE
9998 POKE 534,145:POKE 535,141:REM SHIFT RETURN
9999 END
```

Menu program (contact author—not c/o Microcomputing, *please—for missing part of line 110).*

both Dr. Daley (425 Grove Ave., Berrien Springs MI 49103) and Sawyer Software (201 Worley Rd., Dexter MO 63841). Business Software for the Commodore disk is available from both NEECO and CMS Software (5115 Menefee Dr., Dallas TX 75227). Next time I hope to have more information on these.

It appears that both Dr. Daley and Programma International (3400 Wilshire Blvd., Los Angeles CA 90010) are offering programs on Computhink diskettes as well as on cassettes. (A software announcement for Programma in *Micro* mentioned this, and Dr. Daley notes this option in his brochures.) TIS (PO Box 921, Los Alamos NM 87544) has just announced that their text-editing program, MEDIT, is now available for use with Commodore disk and printer. It is priced at $12.95 and includes an over-40-page manual. It will be interesting to see which disk system will be supported by each of the many PET companies.

New PET to Printer Update

The new PET is a big improvement over the old PET. I haven't yet used a PET printer, but I'm told that it can print uppercase and lowercase letters as they appear on the screen. I don't know why Commodore didn't do this in their 2040-floppy manual. The good news on the manual is that it is only temporary; a final improved version is now being completed. There's a problem in using a printer such as the Teletype 43 via RS-232. Apparently the old PET did not use true ASCII code, and the RS-232 interfaces corrected for this. The new PET sends true ASCII code, which is a good improvement, but either the interface made for the old PET will have to be modified or a program written to convert uppercase to lowercase. If anyone has the answer, please contact me.

Upgrades for Old PET

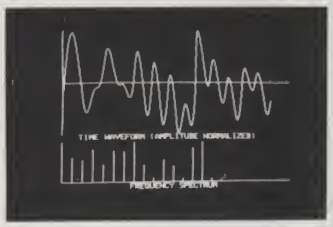
Old-PET owners now may buy a set of new ROMs for their old PET. There are two types of ROMs. Both are packaged in a set of seven ROMs and are priced at $89.95 per set from Commodore (3330 Scott Rd., Santa Clara CA 95050). To upgrade your old PET, simply remove the old ROM set and replace it with the new

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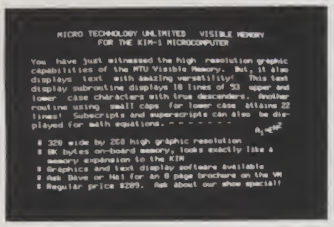
This DOT MATRIX display board doubles as an 8K MEMORY. You can use it as a display, memory expansion or both with graphic and text display software available. You get resolution graphics with no wait states, no snow, and no processor overhead. K-1008 ASSEMBLED and TESTED $240.00, BARE BOARD $40.00 K-1008-1 GRAPHIC/TEXT UTILITY SOFTWARE LISTING $20.00.



As a dot matrix formatted 200 high by 320 wide, it allows high resolution patterns to be displayed and evaluated. It enhances system performance for data acquisition displays, math equation plotting, etc.



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✓ Reader Service—see page 227

ROM set. Once upgraded, your old PET will use the same memory locations as a new PET. Thus, most PEEK or POKEs used in old PET programs will not function properly and may even lock out your PET. You can modify your programs using my conversion chart starting on p. 72 of the July issue of *Microcomputing*. Since programs using machine-language subroutines probably won't work with the new ROM upgrade, what becomes of your old ROM set? Do you throw it away?

Small System Services, Inc. (900 Spring Garden St., Greensboro NC 27403), has what seems to be an excellent answer to this question: a small board that plugs into your ROM sockets. It comes completely assembled for $54.95 and is easy to hook up. Both your old and new ROMs plug into the board, and can be activated with the flip of a switch.

This board is called the Basic Switch. For $149.95, SSS will send it to you with the new ROMs already in the correct sockets, making it even easier for you, plus saving you $5 over purchasing the new ROMs directly from Commodore. A deluxe model will be available with an extra socket or two. You can plug the Programmer's Tool Kit or other software on ROM into these sockets. For more details, contact Small System Services.

(Special note: There are two different types of old ROMs. The new upgrade for the old 6540 set is available now. The new upgrade for the old 6316 set should be available in August. If you order the Basic Switch, be sure to specify your PET serial number and the type of old ROM in your PET so SSS can send you the correct version of their board. You should also know that the Basic Switch board doesn't connect to any of the PET expansion ports, which might be a problem for those with things already attached. Anyone upgrading his old PET directly with ROMs and not using the Basic Switch should save his old ROM set. Who knows—maybe someone will put out a board for the new PET allowing it to use the old ROMs.)

Program Protection Encore

Many software companies are concerned about illegal copying of their programs and are now attempting to protect their programs from being copied. Computhink has a method to protect disk programs with their disk system. I've also discovered an easy method with their system. Of course, I won't tell you how it's done, but any software marketer is welcome to contact me, and I can send an example. CMS Software has developed a method of protection using the PET disk system. NEECO also has worked on a protection method.

```
1 PT = PEEK(50003):SL = 537 - 393*PT:DL = 136 - 87*PT:POKE SL, DL
```

Example 1.

```
900 PT = PEEK(50003):SL = 537 - 393*PT:DL = 133 - 87*PT:POKE SL, DL
```

Example 2.

CMS Software

CMS Software is now offering several comprehensive business software packages for the PET with Commodore dual disk drives. They also are looking for specialized programs to use with their accounting packages. CMS will supply all the subroutines and pay royalties up to 60 percent. I was fortunate to receive a preliminary version of the CMS General Ledger. The diskette with documentation has an announced price of $295. Also announced at $295 each are Payroll with Cost Accounting and Accounts Payable/Accounts Receivable. Contact CMS Software for the name of your nearest dealer.

Software for Schools

Conduit (PO Box 388, Iowa City IA 52240) has 11 software packages in physics, biology and chemistry on cassette for the PET. These programs are described in detail in *Pipeline*, Vol. 4, No. 2. *Pipeline* is available free from Conduit. Simply send a postcard and ask to be placed on their mailing list.

Microphys Programs (2048 Ford St., Brooklyn NY 11229) has announced nearly 100 programs in various subjects, mainly for high schools. Subjects included are chemistry, physics, utilities, math and vocabulary. Several of these programs are also being offered by Commodore. Some of the programs are computer assisted instruction, while others are individualized instruction.

Programs from both Conduit and Microphys should prove useful in the classroom. Commodore also has announced programs for educators. Their programs include a series in elementary language arts written by Thorwald Esbensen. I hope to see these soon. I have seen other programs by Mr. Esbensen, and he does a wonderful job of making them both instructional and interesting for children.

Hardware Reset

International Technical Systems (Box 264, Woodbridge VA 22194) is selling a little device consisting of a push button, which mounts on the side of your PET, and two alligator clips that "hook" onto two locations inside the PET. It installs easily . . . one push of the button and your BYTES FREE message is back on the screen. This is useful if you are doing machine-language programming and you are "locked out." With this button, you won't have to turn your PET off and back on, which is hard on your monitor. A touch of the button resets the PET and clears all memory, and apparently the cassette buffers are left intact—a good side benefit.

Cassette Tape Sources

I've received favorable comments on the following companies' cassettes (please write with your notes on both good and bad cassettes for use with the PET):

Dr. Daley, 425 Grove Ave., Berrein Springs MI 49103.

AB Computers, PO Box 104, Montgomeryville PA 18944.

Computer Applications, Box 203, 446 Newbridge Ave., East Meadow NY 11554.

DAK Industries and Long Electronics have been mentioned, but I have no addresses to list.

Stop Key Disable

To disable the STOP key, your program will have to determine on which version of PET it is running. A PEEK at location 50003 will confirm whether it's a new or an old PET. A new PET will return a 1, while the old PET will return a 0. See my article on p. 72 of the July issue for a discussion on using this information. Briefly, the following line will allow you to use variable PT as the PET Type: 0 PT = PEEK(50003).

To disable the STOP key on the old PET, POKE 537,136; on the new PET, POKE 144,49. Micro Software Systems (PO Box 1442, Woodbridge VA 22193) was kind enough to supply the following modification of my one-line STOP disable (July issue). If executed more than once, my version could cause loss of control. Their version is shown in Example 1. To reenable the STOP key, use Example 2. If you previously assigned PT and SL, you need not repeat the first section of the reenable line. You could then simply use: 900 DL = 133-87*PT: POKE SL,DL.

These lines will operate on either old or new PETs without modification since the lines are "smart" and "know" which PET they are running on. There are possible side effects with this method, however. I believe it messes up the PET jiffy counter. If your program uses it, you may have to either change that section of your program or use another method of STOP disable.

Macro Assembler/Text Editor

This assembler from C. W. Moser (3239 Linda Dr., Winston-Salem NC 27106) is written entirely in machine language, not in BASIC as others for the PET often are. Thus you get fast and accurate assemblies. It is an 8K program, so you need at least some memory expansion for your 8K PET to be able to use this program. It features 26 commands, 22 pseudo ops and 36 error codes. Included are vectors and special commands for use with disk op-

(see PET-POURRI, page 190)

NEW PRODUCTS

Edited by Dennis Brisson

TRS-80 Minifloppy Disk Drive

Percom Data Co., 211 N. Kirby, Garland TX 75042, is advertising a TRS-80-compatible add-on minifloppy disk drive. You can purchase a single, double or triple disk-drive unit to expand your present system. You will need an expansion interface, TRSDOS diskette and TRSDOS manual to use the Percom drives. These same items are required to run the Tandy (Radio Shack) disk drives.

Instant Software, Inc. (ISI), purchased a triple drive unit, which arrived with three Wangco Model 82 disk drives (Pertec FD 200 disk drives are also used), a cabinet with power supplies, a new ribbon interconnect cable, a MICRODOS diskette and MICRODOS manual. Each disk drive is packed separately, and you have to assemble the units into the case. The only tool we needed was a straight-blade screwdriver. The disk drives were ready to be connected to the TRS-80 in about half an hour.

The best surprise came when we tried to run the system. All three disk drives functioned properly right from the start. We had a Tandy single drive that we sent back to Tandy three times before it functioned correctly. The Wangco drives are slower (40 millisecond track access time) than the Shugart drives used by Tandy, but the time difference is not a significant factor during operation. Data transfer to and from the disk drives has been solid and error free.

The MICRODOS is a simple, yet versatile, disk operating system for the TRS-80, but it is not compatible with TRSDOS. MICRODOS is composed of four programs: a menu, a simple disk file manager, disk utilities (which include backup, erase and copy) and the Percom notebook. One of the niceties is a merge command that will merge a routine from disk into a program in memory. This allows building an extensive subroutine file on disk and merging into the program. You write the subroutine once and then call it up anytime you want it.

ISI did have one problem with the Wangco drives. There is an interlock device in these drives that we were activating by finger to get the door closed. The disk drives are mounted on edge in the Percom housing unit. With the housing on its side, the disk drives are horizontal with their doors open. In this position the interlocking device started working properly. This particular door interlock requires proper orientation to function, but this in no way impairs the use of the drives. We overcame the problem of the sticking door interlock.

That the Percom system functioned properly the first time is recommendation enough, but couple that with MICRODOS and its low cost, and you have a good system for the money. Reader Service number P64.

Edward E. Ulmer
Technical Dept., ISI



Percom's TRS-80 triple drive unit.

Imagination Machine

The Imagination Machine is a personal computer and home entertainment center in one. It can be used for educational guidance, home and personal-budget management, as well as for leisure-time activities such as games of skill, chance, dexterity and multi-player competition.

Through a simple hookup with your existing TV set, you can start up your Imagination Machine, which is user programmable. At high resolution, the system's color graphics consist of 128 × 192 characters with up to eight color variations.

Standard features include 10K ROM and 9K RAM memory, typewriter-type keyboard, 53 keys with a unique shifted "BASIC Keywords" button, two game-style controllers, 32 characters × 16 lines screen format, six function built-in cassette tape deck, digital and audio information record/playback, built-in microphone jack, cartridge connector plus an internal operating system and BASIC interpreter.

The Imagination Machine has a built-in music synthesizer with a range of three octaves including sharps and flats. Expandable options include printers, floppy disks, word-processing capabilities and expandable RAM plus coupler modems.

APF Electronics, Inc., 444 Madison Ave., New York NY 10022. Reader Service number A103.



APF's Imagination Machine.



Apple II Business System.

Business System

The Apple II Business System combines all the advantages of a personal computer—portability, accessibility and affordability—with versatile business software. The configuration includes the Apple II Plus Computer, which is an upgrade of the Apple II first sold in 1977, 48K bytes of RAM memory, two disk drives, a video monitor, a printer and the Controller software package.

The system has an expanded version of built-in BASIC that makes it well suited for business problem solving. In addition, an Auto-Start ROM chip provides automatic disk loading as the system turns on, reset protection and easy screen editing. The Controller business software package, designed especially to meet the needs of smaller businesses, consists of three program modules:

In our July 1979 mention of Microsoft's M6800 BASIC (p. 16), we failed to state that the BASIC is licensed only on an OEM contract basis; it is not now directly available to end users.



The LVM-80.



Exidy's Video/Disk.

General Ledger, Accounts Receivable and Accounts Payable.

The Controller package includes a unique fail-safe feature of the data entry system that signals typing errors with an audible warning. The Controller automatically makes copies of data files for historical purposes in case of lost originals and automatically prints reports before the system will allow the user to close out the monthly books. The system costs $4995.

Apple Computer, Inc., 10260 Bandley Drive, Cupertino CA 95051. Reader Service number A28.

Graphics Digitizer

The Simple II is a new digitizer aimed at systems with graphics applications ranging from medical analysis to interactive graphics to engineering design. The Simple II is an 11 × 11 inch self-contained digitizer with 400 lines per inch resolution and 10 mil accuracy. X-Y output is variable up to 240 coordinate pairs per second.

The Simple II, from Talos Systems, Inc., 7419 E. Helms Dr., Scottsdale AZ 85260, will replace the Simple One as the firm's small low-priced graphics digitizer. The new unit will sell for $1065. The Simple II will not replace the 600 series digitizers the firm currently offers, but will serve where high resolution, backlighting or rear projection are not necessary. Reader Service number T70.

Digitized Audio Response System

The Votrax LVM-80 is a solid-state multiplexed audio response system that provides multi-line audio output and Touch-Tone input handling capability for microcomputers, minicomputers and large business mainframes. The vocabulary capacity of the LVM-80 is 512 seconds of speech, or approximately 1024 individually addressable messages. Memory capacity of the LVM-80 is 16K (EPROM) and can be erased and reused should the user require reprogramming of the vocabulary by Votrax.

The LVM-80 communications processor services up to 64 simultaneous telephone lines and, through a process of digitizing actual human speech, can "speak" words and phrases with a quality that is virtually indistinguishable from the original speaker.

Votrax, 500 Stephenson Highway, Troy MI 48084. Reader Service number V26.

Video Display Board

The Electric Window video display board is memory-resident, programmable and displays up to 24 80-character lines. Named the Electric Window because the generated display is like a window through which you can observe the memory space where characters are being input and manipulated, this product is convenient in all applications, but has particular value in text and word processing where the effects of editing and line justification are instantly visible.

Electric Window features include: two character generators—one for standard characters and one that can be programmed for special characters—dual intensity, highlighting alphanumeric display; display scrolling controlled by a single programmable register; descenders on lowercase letters for improved readability; programmable display positioning; and programmable interlaced or non-interlaced scan. The Electric Window is compatible with standard video monitors. The instruction manual supplied with the Electric Window includes a complete operating system listing. An optional PROM operating system is also available. The Electric Window costs $249.95.

Percom Data Company, Inc., 211 N. Kirby, Garland TX 75042. Reader Service number P62.

Video/Disk for the Sorcerer

A new Video/Disk peripheral attachment for the Sorcerer computer from Exidy Data Products, 390 Java Drive, Sunnyvale CA 94086, contains a 12 inch video display and dual mini-floppy disk drives with data storage capacity of 630,000 words. The swivel-based unit attaches directly to the Sorcerer's keyboard enclosure to form a desktop computer system no larger than a video terminal for small-business data processing. The disk drives utilize a unique precision metal positioner to achieve their storage capacity.

The high-performance video display utilizes a P31 phosphor for readability and a 20 MHz bandwidth for clear pictures to easily handle computer generation of 240 × 512 graphic resolution. Software included with the hardware consists of the popular CP/M operating system, Z-80 assembler, text editor, linking loader and Microsoft Disk Extended BASIC. The Exidy Video/Disk costs $2995. Reader Service number E44.

Microcomputer Modem

The Micromodem 100, a complete data communications system for S-100 microcomputers, combines on a single board functions



The Simple II.



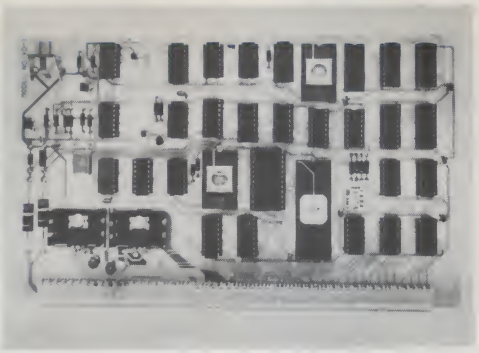
The Electric Window.

that formerly required a modem, an automatic calling unit and serial and parallel interfaces. The new board is a sophisticated computer-to-computer or terminal-to-computer modem for small computer systems.

The Micromodem 100, fully S-100 bus compatible, including 16-bit machines and 4 MHz processors, converts digital data into analog signals for transmission over regular voice telephone lines. Because it is a Bell System 103 compatible modem, it can communicate with the most commonly used modems in North America. It operates at either of two software-selected baud rates—300 baud and a jumper-selectable speed from 45 to 300 baud—and is equipped with an FCC registered Microcoupler data access arrangement that feeds the signal into the telephone line through a modular connector provided by the local telephone company. Because of this direct connect feature, the Micromodem 100 can automatically answer the phone or dial a number. The Microcoupler provides direct access to the telephone system without the losses or distortions associated with acoustic couplers and without a telephone-company-supplied data access arrangement.

The Micromodem 100 serves as a convenient data communications tool between home and office, an automatic data collector from remote terminals, an intelligent terminal and allows implementation of remote software maintenance and customer support. It sends programs, letters and other data over the telephone and provides access to remote data bases. It is software compatible with the D. C. Hayes Associates 80-103A Data Communications Adapter, but offers improved performance and a direct connect and receive sensitivity of −50 dBm.

D. C. Hayes Associates, Inc., 16 Perimeter Park Drive, PO Box 9884, Atlanta GA 30319. Reader Service number H20.



The VDB-1 Smoke Writer.



The Micromodem 100 and Microcoupler.

Smoke Writer

The VDB-1 Smoke Writer is a fast SS-50 bus video display board featuring the MC6845 CRT controller chip to provide total control over display formats. The new board controls an 80 × 24 display with 32 graphic characters and has upper and lowercase characters with lowercase descenders. 128 character graphics are optional. Its programmable character set, a total of 128 characters, is in a 2K EPROM with 256 character 4K EPROM optional.

The Smoke Writer video board's other important features include: reduced intensity or reversed video, programmable display rate (10-5000 characters per second), protected fields, addressable cursor, 2K video display RAM accessible by the CPU as standard RAM memory, 128 bytes of scratchpad RAM and 1K EPROM for software drivers. Either a business program that needs protected fields or a cursor-based editor application will make good use of this video board. Price is $349.

Smoke Signal Broadcasting, 31336 Via Colinas, Westlake Village CA 91361. Reader Service number S46.

Battery-Operated Chess Computer

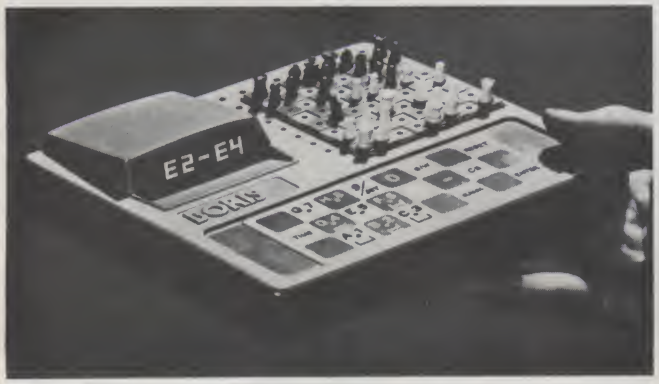
The Boris Diplomat is a full-featured, microcomputer-based chess computer that is designed for travel. It is compact (8 × 7 × 1½ inches), portable and battery operated (operates several hours on six AA batteries, not included, or on the ac adapter, included), with a built-in chessboard with pieces.

Designed with various operational strengths, the Diplomat will play at a level that will teach a child or will keep the attention of a master. As a teacher, it suggests moves for the unsure beginner. The position programmer allows more advanced players to set up special board positions to practice specific strategies. Beginners can use the position programmer to remove pieces for handicapping or for practicing specific positions. Price is $119.95.

Chafitz, Inc., 1055 First Street, Rockville MD 20850. Reader Service number C151.

Computer and Terminal in One

NCE/CompuMart, PO Box 8610, Dept. P1, Ann Arbor MI 48107, combining the PET computer and NCE's own design in a direct spin-off from the PET technology, announces the TC 2001, a computer and a terminal in one unit at a price lower than a terminal alone. The TC 2001 functions as a full duplex, dumb terminal that can be used in conjunction with remote timesharing services, and also as an advanced personal computer. It incorporates one of today's most popular microprocessors, the MOS 6502, for fast and reliable operations. It is available with 8K, 16K of RAM memory. The ROM memory size is 14K. The TC 2001 uses BASIC language (Level II) and is fully expandable through IEEE, TTL parallel, second cas-



The Boris Diplomat.



The TC 2001.

Welcome to Percom's Wide World



SS-50 Bus LFD-400™ and LFD-800™ Systems

Each LFD mini-disk storage system includes:

- drives with integral power supplies in an enamel-finished enclosure
- a controller/interface with ROM operating system plus extra ROM capacity and 1K of RAM
- an interconnecting cable
- a comprehensive 80-page users manual

Low-Cost Mini-Disk Storage in the Size You Want.

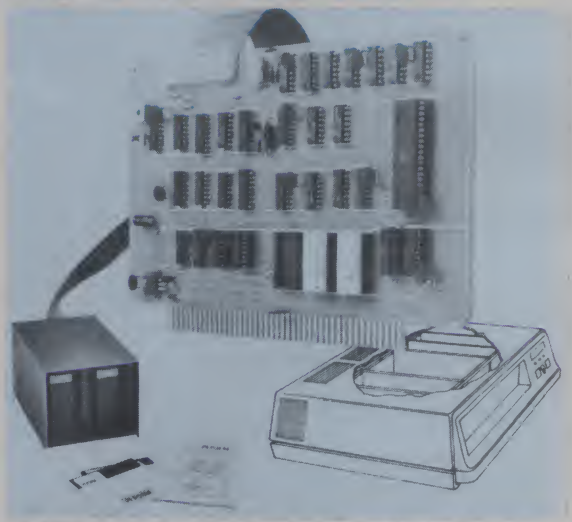
Percom LFD mini-disk drive systems are supplied complete and ready to plug in the moment they arrive. You don't even have to buy extra memory. Moreover, software support ranges from assembly language program development aids to high-speed disk operating systems and business application programs.

The LFD-400™ and -400EX™ systems and the LFD-800™ and -800EX™ systems are available in 1-, 2- and 3-drive configurations. The -400, -400EX drives store 102K bytes of formatted data on 40-track disks, and data may be stored on either surface of a disk. The -800, -800EX drives store 200K bytes of formatted data on 77-track disks.

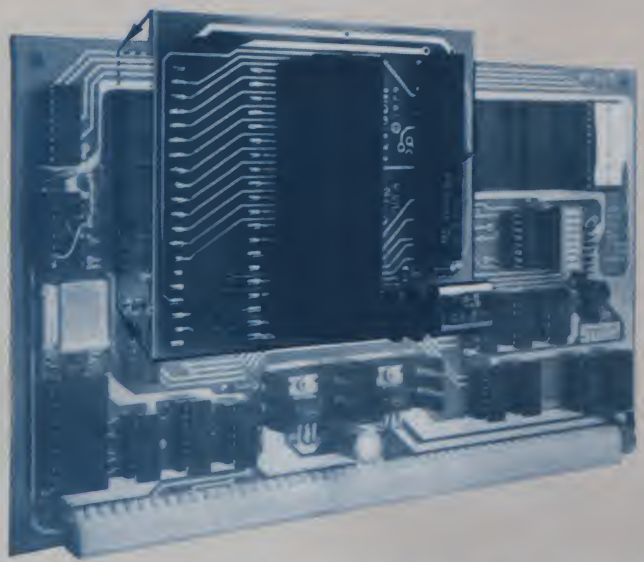
The LFD-1000™ systems (not pictured) have dual-drive units which store 800K bytes on-line. The LFD-1000™ controller accommodates two drive systems so that a user may have as much as 1.6M bytes on-line.

Mini-disk storage system prices:

MODEL	1-DRIVE SYSTEM	2-DRIVE SYSTEM	3-DRIVE SYSTEM
For the SS-50 Bus:			
LFD-400™	$ 599.95	$ 999.95	$1399.95
LFD-800™	895.95	1549.95	2195.95
For the EXORciser* Bus:			
LFD-400EX™	$ 649.95	$1049.95	$1449.95
LFD-800EX™	945.95	1599.95	2245.95
LFD-1000™	(dual) $2495.00	(quad) $4950.00	—



EXORciser Bus LFD-400EX,™ -800EX™ Systems*



Upgrade to 6809 Computing Power. Only $69.95

Although designed with the SWTP 6800 owner in mind, this upgrade adapter may also be used with most other 6800 and 6802 MPUs. The adapter is supplied assembled and tested, and includes the 6809 IC, a crystal, other essential components and user instructions. Restore your original system by merely unplugging the adapter and a wire-jumpered DIP header, and re-inserting the original components. Also available for your upgraded system is PSYMON™ (Percom SYstem MONitor), the operating system for the Percom 6809 single-board computer. PSYMON™ on 2716 ROM costs only $69.95. On diskette (source and object files), only $29.95.

Data Terminal & Two-Cassette Interface — the CIS-30+



- Interface to data terminal and two cassette recorders with a unit only 1/10 the size of SWTP's AC-30.
- Select 30, 60 or 120 bytes per second cassette interfacing; 300, 600 or 1200 baud data terminal interfacing.
- Optional mod kits make CIS-30+ work with any microcomputer. (For MITS 680b, ask for Tech Memo TM-CIS-30+-09.)
- KC Standard/Bi-Phase-M (double frequency) cassette data encoding. Dependable self-clocking operation.
- Ordinary functions may be accomplished with 6800 Mikbug* monitor

Prices: Kit, $79.95; Assembled, $99.95. Prices include a comprehensive instruction manual. Also available: Test Cassette, Remote Control Kit (for program control of recorders), IC Socket Kit, MITS 680b mod documentation and Universal Adapter Kit (converts CIS-30+ for use with any computer).

of 6800 Microcomputing.

6800/6809 SOFTWARE

System Software

6800 Symbolic Assembler — Specify assembly options at time of assembly with this symbolic assembler. Source listing on diskette $29.95

Super BASIC — a 12K extended random access disk BASIC for the 6800 and 6809. Supports 44 commands and 31 functions. Interprets programs written in both SWTP 8K BASIC (versions 2.0, 2.2 & 2.3) and Super BASIC. Features: 9-digit BCD arithmetic, Print Using and Linput commands, and much more. Price $49.95

TOUCHUP™ — Modifies TSC's Text Editor and Text Processor for Percom mini-disk drive operation. Supplied on diskette complete with source listing $17.95

Operating Systems

INDEX™ — This easy-to-use disk-operating and file management system for 6800 microcomputers is fast. I/O devices are serviced by interrupt request. INDEX™ accesses peripherals the same as disk files — new devices may be added without changing the operating system. Other features: unlimited number of DOS commands may be added • over 60 system entry points • display only those files at or above user-specified file activity level • versions available for SWTP MF-68, Smoke's BFD-68 and Motorola's EXORciser*. Price $99.95

MINIDOS-PLUSX™ — An extension of the original MINIDOS™ for LFD-400™ mini-disk systems, MINIDOS-PLUSX™ manipulates files by six-character names. Supports up to 31 files. Resident commands include Initialize, Save, Allocate, Load, Files (directory list), Rename and Delete. Supplied on 2708 ROM with a minidiskette that includes transient utilities such as Copy, Backup, Create, Pack and Print Directory. Price ..... $34.95.

PSYMON™ — Percom SYstem MONitor for the Percom single-board/SS-50-bus-compatible 6809 computer accommodates user's application programs with any mix of peripherals **without** modifying programs. PSYMON™ also features character echoing to devices other than the communicating device, sophisticated register and memory dump routines and more. Price (on 2716 ROM) ..... $69.95.

WINDEX™ — Described in detail elsewhere on this page.

Business Programs

General Ledger — For 6800/6809 computers using Percom LFD mini-disk storage systems. Requires little or no knowledge of bookkeeping because the operator is prompted with non-technical questions during data entry. General Ledger updates account balances immediately — in real time, and will print financial statements immediately after journal entries. User selects and assigns own account numbers; tailors financial statements to firm's particular needs. Provides audit trail. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a comprehensive users manual. Price ..... $199.95.

FINDER™ — This general purpose data base manager is written in Percom Super BASIC. Works wth 6800/6809 computers using Percom LFD-400™ mini-disk drive storage systems. FINDER™ allows user to define and access records using his own terminology — customize file structures to specific needs. Basic commands are New, Change, Delete, Find and Pack. Add up to three user-defined commands. FINDER plus Super BASIC require 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95

Mailing List Processor — Powerful search, sort, create and update capability plus ability to store 700 addresses per minidiskette make this list processor efficient and easy to use. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95.

From the Software Works

Development and debugging programs for 6800 μCs on diskette:

Disassembler/Source Generator $30.95
Reloc'tng Disas'mblr/Segmented Text Gen $40.95
Disassembler/Trace $25.95
Support Relocator Program $25.95
Relocating Assembler/Linking Loader $55.95
SmithBUG** (2716 EPROM) $70.00

½-Price Special on Hemenway Software!

CP/68‡ disk operating system ..... $ 49.97
STRUBAL+‡ compiler $124.97
EDIT68 text editor ..... $ 19.97
MACRO-Relocating Assembler ..... $ 39.97
Linkage Editor (LNKEDT68) ..... $ 24.97
Cross Reference utility ..... $ 14.97

™trademark of Percom Data Company, Inc.
* trademark of Motorola Corporation
‡Trademark of Hemenway Associates Company
**SmithBUG is a trademark of the Software Works Company

And 'looking into' is just what you do with the Electric Window™ as you peer right into memory space where characters are being input and manipulated. Display is memory-resident, programmable and generates up to 24 80-character lines.

Other features include:

- standard character generator plus provision for optional special character generator
- dual intensity, high-lighting alphanumeric display
- scrolling by a programmable register • programmable display positioning
- programmable interlaced or non-interlaced scan
- descenders on lower case letters • users manual with application instructions and listing of WINDEX™ driver.



The Electric Window.™ Worth Looking Into. $249.95

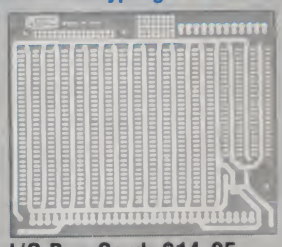
WINDEX™ is a fast video display driver program for the Electric Window™. WINDEX™ also features: program and keyboard control of character generators • displayable control characters — under program control • automatic scrolling • a driver routine for the parallel input keyboard feature of the Percom 6809 Single-Board Computer, the SBC/9™ • auto-linking to PSYMON™, the ROM operating system for the SBC/9™ • Prices: ROM version: $39.95; LFD-400™ compatible diskette (source and object files): $29.95.

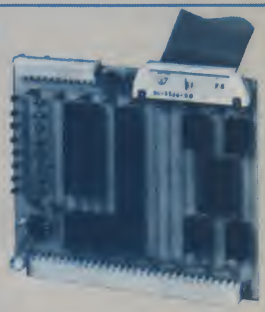
PDQ from PDC!

In the product development queue and available soon: **the SBC/9™** (Single-Board-Computer/6809) — stands alone as a control computer, but also compatible with the SS-50 bus for use as an MPU card. Includes PSYMON™ (Percom SYstem MONitor) in a 1K ROM and provides for additional 1K of ROM. Also includes 1K of RAM. Features: Super Port — provision for multi-address, 8-bit bidirectional data lines • an intelligent data bus for multi-level data bus decoding • an on-board 110-baud to 19.2 kbaud clock generator • extended address capability — to 16 megabytes — without disabling baud clock or adding hardware. And much more. Supplied with PSYMON™ and comprehensive users manual. Price ..... $199.95.

Full Feature Prototyping PC Boards

All of the features needed for rapid, straightforward circuit prototyping. Use 14-, 16-, 24- and 40-pin DIP sockets • SS-50 bus card accommodates 34- and 50-pin ribbon connectors on top edge, 10-pin Molex connector on side edge • I/O card accommodates 34-pin ribbon connector and 12-pin Molex on top edge





I/O Bus Card: $14.95



SS-50 Bus Card: $24.95

- I/O card is 1-¼ inches higher than SWTP I/O card • interdigitated power conductors • contacts for power regulators and distributed capacitance bypassing • use wire wrap, wiring pencil or solder wiring • tin-lead plating over 2-oz copper conductors wets quickly, solders easily • FR4-G10 epoxy-glass substrate.

To place an order or request additional literature call toll-free 1-800-527-1592. For technical information call (214) 272-3421. Orders may be paid by check, money order, COD or charged to a VISA or Master Charge account. Texas residents must add 5% sales tax.

PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERCOM

PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421



The DE-80.

sette and memory ports. Versions are available with either a full industry standard or calculator-type keyboard, which includes a cassette drive. Price of the unit with 8K RAM is $795.

As a terminal, the TC 2001 works at a 300 baud rate. It accepts RS-232 and outputs TTL voltage. The TC 2001 has both upper and lowercase characters, as well as graphics, on the 40 character by 25 line CRT display. A PET computer can be converted to obtain the same terminal capabilities by plugging a module, sold through NCE for $69, into the user port. NCE also offers an acoustic coupler and cable for both originate and answer mode. Reader Service number N7.

Data Enhancer

The DE-80 is an attachment between the Radio Shack TRS-80 and its cassette player to enable you to read marginally recorded data over a wide range of volume settings on the recorder. It will allow you to read either Level I or Level II cassettes from a volume setting anywhere between 4 and 10 on the Radio Shack CTR-type recorders, as compared to between 5 to 6½ if no enhancer is used in between. However, the DE-80 cannot make up for bad recordings or major tape dropouts where data has distorted playback waveforms, hum and variations in amplitude.

The DE-80 consists of a small 4 × 2½ inch box with only the read wire coming in and out of the box. It is inserted between the recorder and TRS-80 so there is no warranty violation from this improvement. The data enhancer also has an LED lamp that glows when data is being detected. The LED is useful for locating gaps between programs when more than one program is recorded on the cassette. Price is $45 with the power supply included.

Microsette Co., 777 Palomar Ave., Sunnyvale CA 94086. Reader Service number M67.

S-100 EPROM Programmer and 4K/8K EPROM Board

The PB1 programming board for 2708 and 5 V 2716 EPROMs is designed to meet all manufacturers' data sheet requirements for programming 2708s or 2716s. PB1 has two separate programming circuits so 2708 or 2716 (5 V) EPROMs can be programmed without modifying the board. Two textool programming sockets are provided for easy insertion and removal of EPROMs being programmed. Programming voltage is generated on-board by a dc-dc converter—no need for an external power supply. Programming sockets are DIP switch addressable to any 4K boundary. Special safety features to prevent accidental programming include an LED indicator and an on/off switch for programming voltage. Software listings are included for checking EPROM erasure, programming and verification.

The board also includes four additional on-board EPROMs that are independently addressable by DIP switch to any 4K (2708) or 8K (2716) boundary above 8000 hex. Unused sockets do not enable data bus drive. The board is fully buffered, and 0 to 4 clock cycle wait states are available. The PB1 has gold-plated edge contacts, plated through holes, low-profile sockets and factory prime parts; the PC board is made of FR-4 blue epoxy and is solder masked for ease of assembly. Price is $145, kit, and $219, assembled and tested.

Solid State Music, 2116 Walsh Avenue, Santa Clara CA 95050. Reader Service number S108.

D/A Converter Board

The Tecmar S-100 D/A board designed for applications requiring high-speed accurate digital-to-analog conversion, including real-time applications, supports four independent high-speed digital-to-analog converters (DACs) with associated latches. Each DAC operates completely independent of the rest. The DACs have a conversion time of three usec, which enables them to operate at maximum computer speed. A 12 bit latch drives the inputs of each DAC. Another four bit latch for each DAC holds the four new most significant bits waiting for the arrival of the new least significant byte. This allows the DAC to hold its previous value until an entire new word is presented to it.

All the latches are set to zero by reset. To modify the contents of a latch, and hence the output of a DAC, send two bytes to the device. The input is a 12 bit two's complement number. User-selectable output ranges of 0 to +5 V, 0 to +10 V, ±2.5 V, ±5 V and ±10 V are available. The board may be addressed as I/O ports or memory mapped. Only four lines of software are required to program these DACs. Price is $395, assembled and tested.

Tecmar, Inc., 23414 Greenlawn Ave., Cleveland OH 44122. Reader Service number T68.

Super Isolator

Now you can protect against extreme interference with the Model ISO-3 from Electronic Specialists, Inc., 171 S. Main Street, Natick MA 01760. The Model ISO-3 includes "superfiltering" for each of three 3-prong sockets. Heavy-duty spike and surge suppression is also included.

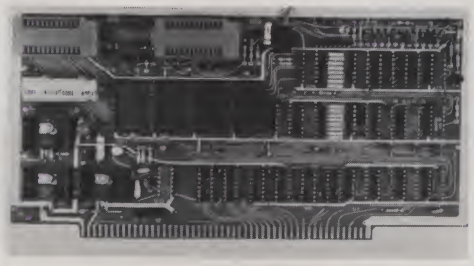
Intended for microprocessor installations in industrial or severe interference-prone environments, the Super Isolator also provides protection against damage from lightning and electrical machinery spikes and surges. It connects to the ac line with a standard 3-prong plug and can isolate and protect an 1875 Watt total load, with each socket capable of isolating a 1000 Watt load. Price is $72.95. Reader Service number E36.

Level II BASIC Shorthand

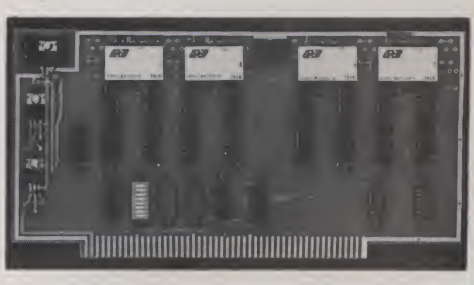
TSHORT is a Level II BASIC shorthand that gives you single keystroke entry for 32 difficult-to-



The Model ISO-3.



PB1 EPROM programmer.



Tecmar's D/A board.

type, long and/or repetitive commands. TSHORT saves considerable programming time—up to 90 percent—and, by providing 100 percent accuracy, eliminates the programmer's biggest frustration—syntax errors. Immediately after each single keystroke entry, the entire command is spelled out in its normal format on the monitor and/or listing, i.e., there is no code to interpret.

TSHORT features a KUSTOM key, changeable anytime, for user-defined functions up to 64 characters of instruction, as well as a self-executing "Go To 10" function (line 10 may contain "RUN"). TSHORT includes the most popular and difficult Level II BASIC commands such as "RIGHT$(", "LEFT$(", "INPUT", "LPRINT", "CLOAD", "PRINTUSING", "GOSUB", etc.

TSHORT comes on cassette—one side for Level II and the other for DOS. What really makes TSHORT easy to use is the set of pressure-sensitive decals (white let-

(see PRODUCTS, page 191)



Keyboard with TSHORT commands.

LETTERS TO THE EDITOR

Overprotective?

I want to comment on the topic of protected programs. To put my remarks in context, I should mention that I am writing and have programs for sale and have had articles accepted to be published in current trade magazines. All this means is that I have some stake in the issue of copyright. No doubt I would be furious if someone copped my programs for his own and went into competition with me.

However, there is another side of the coin that should be considered before we all go running off to put a lock and chain on our programs. I've never met a program that I have not wanted to change to meet my own idiosyncracies. Even more important is that in this industry we have managed to develop a myriad of incompatible systems . . . even with the same names. For example, I could run a Cursor program designed for 8K memory on tape, but if that program was designed to use a cassette file system I'd sure want to convert it to disk files. I could not do that on a protected program.

What about the differences—not trivial—between the 8K PET, the CMC and the new 16/32K graphics version? Although a lot can be done to program around these differences, I doubt that we will be able to ever get to write a "universal" program. I can't.

In my mind there is no way to handle a good utilization program without allowing for modifications for a use peculiar to the user, and that's what we are writing for. One solution may be a method to protect segments of a program while allowing modifications of those areas that need to be customized.

Also consider for a moment what are the potential sources of program violation. I think that out-and-out plagiarism is minimal, and there are legal means of dealing with this. The major source or irritation lies with the "make a copy for me" syndrome between friends. This significantly reduces the market for the author of the program.

I believe that this problem can be minimized by good leadership in the user clubs and education of the potential users by editorials and letters such as this. I also think that this is the only solution because if someone is smart enough to protect a system, then there is always someone else that is just a little bit more clever who will find a way around the block. Micros are just too simple.

One final thought on the subject. The development of American literature is based upon the examples of the past. I feel that much the same idea applies in the area of good programming. One learns from concrete examples of successful programming on the market. The plethora of books on beginning programming and the dearth of any good material on advanced programming is readily evident. In my opinion, the widespread use of protected programs will adversely affect the quality of our industry in the long run.

In conclusion, I think the authors and publishers of programs should consider carefully the potential impact of protected programs prior to utilizing that technique. At least if one is marketing a protected program, then he should identify the fact so the buyer knows what he is getting.

Paul W. Sparks
Gales Ferry CT

"Whipping" POKE

When you append two or more programs (see Roger L. Pape's "Whip File Wipeouts," July 1979, p. 39), it may be necessary to add the step CLEAR:RESTORE in the command mode if your memory size disagrees with what it should be (add this step after re-POKEing the start of the program pointer to its default value).

In addition, it should be noted that the start of the program pointer will not always be 16548,233 and 16549,66. If TRSDOS is up, for example, it will be 186 (LSB) and 104 (MSB).

If you use someone else's disk system, or some newer or older version than 2.2, PEEK these locations without a program in the RAM and use those values. Keep in mind that to PEEK or POKE above 32767 you must use the formula: −1*(65536−desired address).

Robin L. Salmansohn
Abington PA

For the Birds

I personally feel we are wasting our time and energy, especially in printed form, for gadgets and games whether "hard or soft." I'm really upset about the enormous press coverage some *cheap* systems, i.e., TRS-80, are getting. I do not think a system should become a standard just because it has numbers. (Starlings, blackbirds and crows are not national birds.) I feel the microcomputer is headed for the "back door," and that's a "10-4." Let's at least make this electronic machine a little more useful to society. Let's start interfacing with the *real world!*

Tim Ziller
Grand Island, NB

Tim, I can see you're gonna just love my new magazine, 80-MICROCOMPUTING. Oh, I agree with the need for gadgets to permit our systems to reach out and accomplish tasks such as lawn watering, feeding the English sparrows, scratching our back, replacing our aging mailman. Go take a 10-100, good buddy.—Wayne.

−=−; +=−

Greatly enjoyed "Murphy's Laws" (August 1979, p. 44).

Dzwonkiewicz's maxim: Negative thinking produces negative results. Positive thinking also produces negative results.

Dorsey F. Burk
Rancho Murieta CA

Meet You in Philly

I am involved in trying to develop, for profit, microcomputer applications for certain areas of the health-care industry, and I would like to establish communications with other individuals and organizations who are inter-

ested or involved in this particular area of microcomputer endeavors. Also, I am planning to attend "Personal Computing '79" in October in Philadelphia. I am hoping that I might get a chance to meet some of these people while I'm there. In fact, I'm proposing to get together during that weekend in Philadelphia such a group who, for now, I will call Health Care Microcomputer Entrepreneurs.

In addition to wanting to hear from anyone who is interested in this area of activity and who wants to exchange correspondence, I would like to receive specific indications of interest and intent from those individuals who would be interested in participating in such a meeting during that weekend (October 5-7).

Thomas H. Swalenberg
HCSMS
PO Box 13089
Columbus OH 43213

OK, your letter has been published. Now I expect you to keep Microcomputing *readers up to date on what develops.—Wayne.*

More on Morr

Many thanks to Dave Morr for his "TTY" program in the August 1979 issue of *Microcomputing* (p. 38). The program is *fast*, and it makes BASIC listings very readable thanks to the special symbols used in the printout. For those of you who are using a 60 wpm Baudot machine, as I am (Teletype KSR-32), a couple of changes that I've found successful might be of interest.

As mentioned in the article, location 7F93 must be changed; I found that 24 hex was the right value for my machine. I also found that, apparently due to the speed of the program, reversing the carriage-return and line-feed routines produced better results. This involves changing 7EFD to 02 and 7F02 to 08. If you prefer a 64-character-wide paper printout so that it will match the CRT of the TRS-80, then change 7EA1 to 3F. To use the cassette motor control relay for keying as shown in Fig. 2 of the article, simply change 7F88 to 14.

Before running the TRS-80 for a hard-copy printout, make sure that your TTY's carriage is returned and that the machine is in the LETTERS mode. The program does not print on the CRT screen when talking to the TTY, but this is very seldom needed anyway. Again, many thanks to Dave Morr for making available his well-thought-out program, and I hope that these tips may be of value to some readers.

David F. Miller
Niles IL

I want to commend you on your continuing publication of excellent applications articles for the TRS-80. An an amateur-radio operator, I was especially pleased with the article by David Morr on using the Baudot teleprinter for TRS-80 hard copy. The software ran nicely without modification, except that I got no automatic CR-LF after 72 characters.

However, when I first entered it and then typed LLIST or LPRINT, nothing would happen. Then I discovered that the driver addresses were not loaded at 16422 and 16423 decimal. I found that by adding the following BASIC statements:

```
POKE 16422,176
POKE 16423,1267
```

the program would function properly. Keep up the good work, and how about some RTTY-oriented Baudot input-output programs for the TRS-80?

PS. I used Rod Hallen's "Monitor" program from the June 1979 issue to load Morr's hex listing!

A. Podolsky, M.D.
Oak Park MI

It is not Baudot code, it is Murray code (see June 1978, p. 4). Those confounded Frenchmen have been taking credit for this for too long. Murray was an American, and our printers are and have been using Murray code and not Baudot. Got it? Other than that, thanks for the additions and notes; any others from other users of the system will be appreciated. The whole idea of this magazine is to allow computerists to help each other—Wayne.

Lawn Care by Computer

In "Machine-Language Monitors for the TRS-80" (August 1979, p. 114), author Robert Edmonds recommends that persons learn 8080 code first because it is a subset of the Z-80 code.

This is a common mistake; it arises because Zilog engineers wanted to preserve compatibility with existing software. However, the additions are not mere "enhancements." They comprise a different logical architecture that is more elegant and efficient than that of the 8080. Optimal Z-80 code is structurally different than 8080 code. This is primarily due to the index registers and bit operations; although there are lots of registers, memory operation capability has been significantly increased. While 8080 code must always shove data through the single accumulator, I find that fewer than half of my Z-80 subroutines ever access the accumulator at all. Because I learned 8080 first, it took me months to learn to program that way, but now my subroutines are faster and only half as long.

Furthermore, "Intel standard mnemonics" are very confusing, and when applied to Z-80 op codes, incomprehensible.

Come on, people, teaching 8080 code first is like teaching people to cut their lawn with a sickle before they can learn to use a riding lawnmower. It's a waste of time.

Richard Rodman
Vienna VA

So write an article telling us how to start writing Z-80 code, or at least give a good reference to read on it.—Wayne.

The Movie Was Great . . . .

I purchased Rodnay Zaks' *Programming the 6502* on the basis of your review in the July 1979 issue. Your reviewer mentioned: "On the negative side, Zaks' book contains a lot of typographical errors . . . most of them are trivial . . ." This is the understatement of the year! This book contains not only "lots," meaning hundreds, of trivial typos, but is generally illiterate in English construction, (Example, on page 46, "Exercise 3.1: Close now this book.")

However, more important is Zaks' lack of precise understanding of the 6502. I thought I could pick up some pointers on the 6502 from this book, but it is so rife with substantial errors that you must check every line if you really wish to use it. For example, on page 219 he has the code:

```
. . .
ADC #$00 RESTORE BIT
ROL CHAR SAVE BIT IN CHAR
. . .
```

After the ADC command, the carry will be clear. The ROL will always rotate a zero into CHAR so the bit won't be saved in CHAR!

If I buy a book, I prefer it to be mostly correct. Then I can learn from it and not always have to be on the defense against minor and major errors. With this book, I feel I was robbed! Almost anyone, novice or not, is going to have a hard time with it. Your reviews should provide such warnings!

Kendal T. Rogers
Fountain Valley CA

I'd like some more opinions on this since most of the comments on the book have been enthusiastic. Ken, aren't you blowing a few minor things out of proportion? There are some really lousy books on the market; let's go after these. Readers, if you get suckered into buying a bad book, please do write in so we can pass the word, but be sure you have it in perspective.—Wayne.

Plus and Minus

Let me take this opportunity to thank you for a great rag—one that is well worth the air-mail postage to New Zealand. Thank you for the advice to jump in and get my feet wet by buying some kind of micro even before I fully understood what was really going on.

I have been a computer "professional" for the last 11 years, but am now learning things about computers I never knew. It is reasonably difficult to stay up with the play at this distance, although we have an active club here in Auckland.

Some U.S. vendors are much more helpful than others. I'd like to put a plus by the names of Jade and Personal Software, and a minus by the names of Commodore and Ohio Scientific.

Jim Kennedy
Auckland New Zealand

Thanks

Since your publication of my letter (July 1979 Computer Clinic) asking for help in obtaining previous *Popular Electronics* articles on the COSMAC Elf there has been a tremendous response from your readers, and I have received all the information needed, and more, on the COSMAC Elf. Among your readers who sent copies of the Elf articles were Mr. Don Hartley, AR; Mr. John Lund, IN, Ms. Joyce Weisbecker, NJ; and Mr. Jeff Duntemann, NY. I would like to thank them for their enthusiastic help.

Moses Huang
Singapore

Food for Thought

Someday, every child will benefit from computer-assisted instruction.

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For the Apple*

Math Tutor I

The Math Tutor I package is designed to help younger children learn the concepts of mathematics. It uses the technique of positive, immediate reinforcement. When the child enters a correct answer, he or she is rewarded with the opportunity to move a spaceship, cast a magic spell, or rescue a man from a most unfortunate fate. By using this method of positive reinforcement, children will learn to associate mathematics with pleasant experiences, as opposed to the stark reality of numbers that has driven so many pupils to an early dislike of math. The program also provides the opportunity for parents to indulge in a unique learning experience with their children, while introducing them to the exciting world of microcomputing. Teachers can also use the program in a classroom setting to provide that extra incentive. Math Tutor I contains the following programs:

Hanging

A variation of the traditional game of Hangman. In Hanging, students must spare the graphic character's "life" by correctly answering the questions posed by the computer.

Spellbinder

The student is cast as a magician competing against another magician who's controlled by the computer. He must answer the questions about fractions correctly in order to cast magic clouds, fireballs, and other spells at his rival.

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The student is given the opportunity to lead an attack on an evil planet. Every time a correct answer is given to a math problem posed by the computer, he can move his ship closer to his goal. Every wrong answer gives the enemy an opportunity to fire back.
Order No. 0073A $7.95

Note: The Hanging and Spellbinder programs require Applesoft II BASIC. The Whole Space program can run in Integer BASIC.

Math Tutor II

Math Tutor II is designed to complement the Math Tutor I package and introduces students to more advanced mathematical principles. Again, it uses the technique of positive reinforcement by offering rewards for correct answers—a principle long recognized as effective in helping students develop healthy attitudes towards study. To keep pace with individual pupil's development, all of the programs in this package may be used with any one of four levels of difficulty. Package includes:

Car Jump

Make the car jump over the buses. Every time your student correctly calculates the areas of various geometric planes, the number of buses in the line is increased by one.

Robot Duel

Each time a student correctly answers a question involving volumes of geometric solids, he's allowed one shot at the computer "robot." For every incorrect answer, his shield power drops, and the enemy robot is given the opportunity to shoot back.

Sub Attack

Students get to practice using percentages as they maneuver their sub into the harbor. A correct answer lets them fire their torpedoes at the enemy fleet.
Order No. 0098A $7.95

Note: All programs in this package require Applesoft II BASIC.

*Apple and Applesoft II are trademarks of Apple Computer Inc.
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See page 71 for valuable coupon offer

For the TRS-80**

Teacher

This practical program allows you to input any number of questions and answers from the fields of science, languages, history—you name it. Using this data, the computer will prepare several types of tests, quiz students—providing up to three hints per question—even offer graphic rewards for younger children, all at the user's discretion. True or False tests may also be given.

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Thoughts on the SWTP Computer System

Part 6 of this series finds a coauthor, Phil Schuman. In this installment, Pete and Phil take a close look at three of the six disks that are available for the SWTP computer system.

There are six disk systems available for the SWTP system at this time—three large floppy and three mini-floppy. The large ones (Midwest Scientific Instr., SWTP and Smoke Signal Broadcasting) are more expensive and quite possibly outside the reach of many. But the three minis are more reasonably priced, and are the subject of this review. They are:

The LFD-400 from Percom Data Company, 211 N. Kirby, Garland TX 75042, at $600 for a wired single-drive system or $1000 for a wired dual-drive system.

The BFD-68 from Smoke Signal Broadcasting, 31336 Via Colinas, Westlake Village CA 91361, at $800 for a single-drive wired, $1140 for a dual-drive system or $1480 for a triple-drive system. A less expensive single-drive system ($650), called the ABFD-68, comes without case or power supply.

The MF-68 from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio TX 78216, at $900 kit, $1000 wired for a two-drive system.

There are also several hybrids among these systems. Smoke Signal sells an MF-68-U kit, which includes the SSB controller board, to change an SWTP MF-68 system into an SSB-compatible system that will run SSB software. It costs $270. (With this kit, some drives, a case, power supply and cable, you could build your own SSB-compatible system.)

Peripheral Technology Associates, 3848 Hampton Dr., Columbus GA 31904, sells a disk controller, model FD-1, which is compatible with SWTP MF-68 software ($27 for a bare board, $110 for a wired controller). With this board you could change an SSB or Percom system into one compatible with SWTP MF-68 software. (Or, with your own drive, case, power supply and cable, you could build your own.)

Likewise, Percom sells their controller separately for $115, wired; using this you could modify an SSB or SWTP system into a Percom, or build your own.

The Micro Works, PO Box 1110, Del Mar CA 92014, offers a retrofit kit (model DM-85 at $40) for combining 5-inch mini and 8-inch regular floppy drives on the same SSB disk controller. It only works with later controller boards.

Disk System Hardware

A complete disk system consists of two parts—the hardware and the software. One is no good without the other. Moreover, there has to be good software support; the world's best hardware will do you no good without a good selection of software available. Let's talk about the hardware first.

Mini-floppy disk systems consist of several parts. First, there is the controller. This printed circuit board contains the electronics for controlling the disk drives and mounts inside the computer. The SSB and Percom boards are large and fit into the 50-pin bus in the SWTP system, next to memory or CPU boards. The SWTP controller is a smaller board that plugs into the 30-pin I/O bus. (If your system is already overloaded with boards and has no empty slots in one bus or the other, your decision is made right here.)

Then there is the drive. All of the commonly used drives, such as the Shugart SA-400, Wangco model 82, Pertec or whatever, are exact replacements for each other. They have the same mounting screws, the same connector and the same connections. You could mix two different drives in the same system, although there are good reasons not to do so. There are slight differences: Some drives allow you to flip a disk over and use the back, some may move the head from track to track a little faster and some may have more tracks.

The drive has to be mounted in a case and connected to a power supply. Since the controller board is powered by the mainframe, the power supply is only for the drive or drives. It mounts in the same case. There are small differences here among the three systems.

Percom's basic one-drive system comes in a small case for just one drive; it has a small supply only capable of powering one drive. A two-drive system has a larger case and two power supplies. Updating from a single-drive system to a two-drive system either results in two separate one-drive cases or requires an extra charge for a larger case.

The SWTP case comes with two drives and a power supply for two. (Expanding beyond two requires a second case and power supply.) It's not available with just one drive.

The SSB case and power supply are adequate for three drives, regardless of whether you buy the single, dual or triple system.

Connecting the controller

with the drives is a cable. Most systems use a 34-wire flat cable with crimped-on connectors at both ends. In multi-drive systems, one end of the cable simply has two or three connectors, separated by about 6 inches, which connect the same cable to all drives at the same time. With the exception of three wires in the cable, which select a particular drive, all other wires are shared among all three drives.

This makes the wiring simple, but has one disadvantage: When you read or write on one disk, all the drive motors go on together. This lack of independent motor control means that there is wear and tear on the unused drives and disks as well.

The disk drives and the Percom and SSB controllers use 34-pin two-sided card-edge connectors; the SWTP controller uses an AMP 87365-4 pin-type connector. Thus the same cable could be used for either Percom or SSB controllers, but another connector has to be installed if it is to be used on the SWTP controller. (By the way, the Radio Shack TRS-80 also uses a card-edge connector, so the same drives and cable could be used on SSB, Percom and TRS-80 systems.)

Software Requirements

Along with the hardware, you need some software. This is where the big differences really are among various systems. As far as the hardware is concerned, the three systems are all differently designed and built, but basically all work equally well. For most people, it's the software that sways them from one system to another.

Disk software consists of two parts—the disk operating system, or DOS, which is the entire package of software used to control the diskette, and the application programs, such as a BASIC interpreter, assembler or editor, which are used with the DOS.

The DOS is the essential program that controls everything the disk system does. It is usually broken down into three areas of responsibility: commands, the monitor, file management.

The commands are groups of programs that will perform selected functions, such as LOAD or SAVE, for the user. A basic set of commands is usually supplied with the system; some additional commands may be available at extra cost, and the user has the option to write his own commands in assembly language or add other software that will be treated as commands.

The monitor is that portion of the system that will maintain control, prompt for and check syntax of commands and interface to file-management routines. The monitor is usually a set of subroutines that may be accessed by the user (in assembly language) by way of a jump table, with an instruction such as JSR GETLINE or JSR ERRMSG.

The file-management portion is the set of routines and supporting work areas that access the diskette for reading and writing. In addition, a directory is maintained to ease in the searching of the diskette for specific files.

All of these components of the DOS may be resident in memory, but usually the commands and other low-usage routines are kept on the diskette and only loaded into memory as needed.

In addition, some DOS systems have other functions. There is sometimes a set of routines for terminal I/O, that is, for communicating with the terminal. For example, the SWTP DOS has its own routines for communicating with the terminal, while the SSB DOS uses the MIKBUG or SWTBUG ROM to perform the actual I/O.

When the computer system is first started, there must be some way of starting up the DOS. The SSB and SWTP systems keep all of the DOS on the diskette and require a mini loader to read the beginning portions of the DOS into memory. Once enough of the DOS is able to run, it loads the rest of itself into memory. The function of reading the beginning portions of DOS into memory is called booting, and the mini loader program is called the boot or bootstrap. In the SWTP system, the disk boot is in SWTBUG; in the SSB system, it is in ROM on the controller board; in the Percom system, the entire DOS is in ROM and does not have to be booted.

Another word to learn is IPL, or initial program load. This is the logical sequence of bringing a DOS up to a state of readiness. This may involve a booting, along with any other housekeeping functions, before the system is ready for commands.

Let's introduce another word that will be used later. A diskette has a *write-protect* notch along one edge. When this notch is left uncovered, that disk is unprotected and can be written on. But when a piece of tape is placed over the notch, the system senses the tape and will not write on that diskette. Hence the diskette is write-protected—protected from being written on.

With this introduction, let's look at each disk system one at a time.

SWTP MF-68

The SWTP MF-68 consists of a large cabinet with two drives, a power supply, controller board, connecting cable, a DOS and Disk BASIC. The DOS is called FLEX and is written for SWTP by Technical Systems Consultants, Inc. (TSC, Box 2574, W. Lafayette IN 47906). Although only two drives are supplied, two more can be added with an expansion kit.

The controller plugs into port 6 of the I/O bus in the mainframe. But it requires that a jumper be placed across two pins in I/O slot 5. SWTP suggests that you pull out the motherboard and solder the jumper underneath, but a much easier way is to simply plug a few extra female Molex connectors of the type used on the I/O boards into slot 5 and connect the pins on top. In any case, this jumper uses one of the user-defined (UD) lines on the bus and also makes it difficult to use port 5 for any other purpose (since its select line is being used by the disk). Thus the controller really uses up two I/O slots.

The controller uses the Western Digital 1771-01 floppy disk controller chip for disk formatting and is fairly uncomplicated, with just 13 ICs. The 1771-01 chip does all the work; most of the other ICs are used just for buffering inputs and outputs.

The bootstrap may be entered by hand, or you may use the disk bootstrap in SWTBUG. DOS occupies 4K of RAM at addresses 7000-7FFF; in addition, certain FLEX commands require a large buffer area, and, therefore, the system also requires at least 12K of RAM starting at address 0000. This area is used fairly seldom, however, and is otherwise available for programs (such as to hold the BASIC interpreter, for instance).

FLEX has its own sophisticated terminal I/O routines and, therefore, does not depend on the ROM monitor to provide this function. This means that any programs you write should use the FLEX I/O routines, rather than MIKBUG or SWTBUG I/O routines. This is somewhat of a problem; FLEX contains equivalents of the INEEE, OUTEEE or PDATA routines of the ROM monitor but does not have some of the others you might use, such as OUT2HS or BADDR. Hence, it may be difficult to work your way around it.

The system uses soft-sector diskettes, which have only one index hole and therefore have to be formatted before they can be used. This is done by the DOS, but requires several minutes for each disk.

The FLEX disk operating system is included in the price of the disk system (although TSC is now supplying a more versatile DOS called FLEX 2.0 on their own, at a price of $75).

FLEX commands reside on the diskette. The system comes with a basic set of commands. Also, TSC has written additional ones and sells them at extra cost, and commands can also be written by the user. Any executable file on the diskette may be used as a command; FLEX will attempt to load and start executing any command entered on the terminal. The command names, therefore, do not have any special naming conven-

tions. If, for example, you enter the word CLOAD, FLEX will look on the diskette for a program by that name to execute. If the program exists, it will be loaded and run. Hence, additional commands, beyond the functions that FLEX normally has, can be easily added to the system.

FLEX prompts the user with + + + and uses control-H or some user-defined character as the back space. The control-X is used to delete an entire line. A FLEX command called TTYSET controls these and other characteristics of the terminal. For instance, TTYSET controls the line length, whether the system echoes or does not echo characters being input, and so on. This command sets the total environment as far as the terminal is concerned. It even keeps track of the number of lines printed, so that output can be separated into pages on the printer. A pause option allows the output to stop at the end of a page; hence, users with CRT terminals can set up the paging and pause so that FLEX will fill up an entire screen with output and then wait until the user has read it before going on.

Since the SWTP disk system is normally supplied with two drives, it has provisions for using each drive for a different purpose. Using the ASN, or assign, command, you can assign one disk as a system disk and the other as a working disk. The system disk will have the DOS, its commands, BASIC interpreter, assembler or editor, while the working disk will have the data files used by these programs. This has the advantage that you can write-protect the system disk and protect it from accidental erasure by an errant program, while leaving the working disk unprotected so it can be written on.

FLEX Commands

Here is a short summary of FLEX commands supplied with the system. (There was an excellent review of this DOS by Mickey Ferguson in *Kilobaud*, October 1978, p. 72.) These commands are referred to as the Utility Command Set, or UCS, or sometimes just as disk utilities.

The first two commands are part of the DOS and sit in memory all the time:

GET—load a file into memory and return to FLEX.
MON—return to monitor (MIKBUG or SWTBUG).

The remaining commands reside on the disk and are called into memory only when needed:
APPEND—merge two or more files into one.
ASN—assign system and working disk drives.
BACKUP—create a mirror-image copy of a diskette.
BUILD—create a small text file.
CAT—list a directory of diskette on specified drive.
COPY—copy selected files from one disk to another.
COPYNEW—copy only those files that do not already exist on the second disk.
DELETE—delete a file from the disk, erase its name from the disk directory and free up the space formerly used by it.
EXEC—process a text file as a list of FLEX commands.
JUMP—start executing a program at a specified address.
LINK—set a pointer to inform the bootstrap program where to find the FLEX DOS on the diskette.
LIST—display the contents of a text or BASIC file.
NEWDISK—format a blank diskette with soft sectors.
P—steer the following command to use a parallel printer on port 7 instead of the terminal.
RENAME—change name of file.
SAVE—save a specified region of memory on the disk and optionally assign it an execution address so it can start executing when reloaded.
SAVE.LOW—used to save commands that will be loaded into the higher memory addresses used by FLEX.
TTYSET—set terminal characteristics and environment.
VERIFY—reread the disk after every write to check that there were no disk errors.
VERSION—display the version number of a specified command.
BASIC—start the BASIC interpreter.

In addition, FLEX has provisions for a file called STARTUP.TXT, which can contain a set of commands that will automatically be executed as soon as FLEX is booted. Hence, all the assigning of terminal output, system disk, working disk or other system parameters can be automatically done at start-up or IPL. This is specially intended for beginners or business users who don't want to be concerned with the nitty-gritty of booting the system and getting it going.

FLEX Features

FLEX maintains a directory on each disk of the files that are stored on it. File names consist of one to eight alphanumeric characters (the first of which must be a letter), followed by a period and a three-character extension, which specifies the kind of file it is. For instance, commands have the extension .CMD; text files end with .TXT; BASIC source programs have an extension of .BAS.

The diskette is divided into 35 tracks, and each track is further divided into 18 sectors. One track is reserved for the directory, with the remaining 34 tracks holding a total of 612 sectors. Each sector contains 124 data bytes, for a total usable disk capacity of 75,888 bytes. But since the DOS has to be on at least one disk, the first disk's capacity is closer to 50-60K bytes; only the second and following disks in a system will generally have the full amount usable.

Within a disk, sectors are allocated dynamically. That is, a given file may be spread out all over the disk, not necessarily in adjacent sectors. When starting with a blank disk, a disk-formatting process numbers all sectors and chains them together. That is, the directory holds the address of the first empty sector, that sector holds a pointer to the next empty sector, and so on down the line. Each sector is chained or linked to the next one. This is called a linked list, which links together all the empty sectors.

While DOS is formatting the disk, it is also checking each sector to make sure it has no defects and can store and read back data without errors. Any defective sector is automatically removed from the disk simply by not being linked in the chain of empty sectors. In this way, the DOS can use a disk even if it is not perfect.

When a file is placed onto an empty disk, it goes in the first empty available sectors, and then the pointer in the directory is updated to point to the first empty sector beyond that. As a disk is filled up, each file goes into the next empty sector in the chain.

At this point, there is one linked chain of all the empty sectors; in the directory, there is one pointer that points to the first of those empty sectors. Moreover, for each file on the disk, there is a directory entry that points to the first sector used by that file. Each sector, in turn, points to the next sector of that file. In both cases, the chain ends when the last pointer is 0000, indicating there is no more.

But when a file is deleted, its name is erased from the directory and its sectors are released, that is, their chain is added to the chained link of empty sectors. Now when a new file is added to the disk, it may start to use space that has been released from previous deletions.

In an intelligent DOS, new files will be placed into those areas of the disk that are big enough to hold them, if at all possible; in a dumber DOS, they will simply be placed into the first sectors in the chain of available ones. FLEX uses the latter technique, but either way, often there will be no single place big enough on the disk to hold a new file. In that case, it will get spread out among sectors all over the disk.

This has several advantages and disadvantages. Released space is immediately available to new files, rather than empty sectors being left here and there, unused. (For instance, Percom's disk doesn't do this; when a file is deleted on the Percom system, its sectors are attached to the file just before it on the disk. They cannot be used by other files until a PACK

program is run to pack all the used sectors together and close up all the empty holes.) Since files get spread out all over a disk, this evens out the wear on the disk surface, rather than concentrating it at the beginning of the disk.

On the other hand, when files are spread out all over the disk, more time is needed to read and write programs. For instance, it takes several times longer to load a large program from the SWTP disk than to load the same program from the Percom disk. Thus, it may be necessary to reorganize a FLEX disk occasionally, if just to speed up the access time.

FLEX handles disk I/O with its File Management System (FMS). These routines are resident in memory, accessed via a jump table, and provide the necessary functions to access a file.

BASIC and other application programs available for use with FLEX take care of reading and writing disk files automatically. But it is also possible to use the disk for programs written in assembly language. In this case, all diskette I/O functions are scheduled through a user-created work area called a File Control Block (FCB). An FCB is required for each file while it is being used. Several routines are available in FLEX to assist the user in properly loading the FCB with the correct information. Once it has been properly primed, it must be opened for I/O; after the I/O operations are complete, the FCB must be closed.

These functions are requested by placing the appropriate function code in the FCB and calling the FMS. The FMS routines, in turn, will handle the disk-related I/O and process a character at a time for the user. This is convenient for the programmer, since most non-disk programs operate with character-at-a-time I/O and are easily adapted to disk for this reason.

FLEX supports normal sequential access, along with random access. In addition, space compression and other special options are available, if requested in the FCB.

However, these are all functions not spelled out in the FLEX manual that comes with the disk system; you must purchase *DOS Advanced Programmer's Guide* for $5 to learn how to use them. This manual describes how to use disk I/O for assembly-language programs, but does not give any source listing of FLEX. Hence, you cannot go beyond the standard techniques as they are described in the manual. No source listings of FLEX or its commands are available.

FLEX is a versatile DOS and has an excellent collection of related programs available for it. The basic FLEX, which is supplied with the SWTP disk system at no charge, is called mini FLEX, but even so it is quite a package.

TSC is now selling several other versions of FLEX, including FLEX 2.0 for the SWTP disk ($75), FLEX 2.0 for the Smoke Signal Broadcasting mini-disk ($90) and FLEX 1.0 for full-size Smoke Signal disk. The new FLEX systems require 8K of memory from address A000 through BFFF (which means you may have to add one or two more memory boards), thus releasing all of the lower 32K of memory for user programs. (Since FLEX is then in a new area, old FLEX commands or programs will have to be changed to work with it.)

The new TSC FLEX versions differ from mini FLEX in a number of important ways. First, the new FLEX offers more storage per disk. Instead of 18 sectors per track with 124 data bytes each, the new FLEX formats the disk with ten sectors per track, with each track having 252 bytes of data. One track is reserved for the directory, so that the remaining 34 tracks hold 340 sectors, for a total of 85,680 bytes (instead of the 75,888 bytes in mini FLEX). New FLEX disks, therefore, have almost 13 percent greater storage capacity than mini FLEX disks, though this becomes significant only when each file is relatively large. This is because a small file of, say, 120 bytes takes up one sector in both systems; but in the 124-byte sectors of mini FLEX it

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wastes only four bytes, whereas in the 252-byte sectors of the new FLEX it wastes 132 bytes.

Since each sector contains twice as many bytes in FLEX as in mini FLEX, a given file will contain only half as many sectors. One reason for the slow speed of FLEX is that after every sector is written, FLEX waits for the disk to turn around and then reads the sector to make sure there are no errors. Since the new FLEX contains only half as many sectors in a given file, this process takes only half as long. Thus the new FLEX is faster than mini FLEX.

A major feature of the new FLEX is printer spooling. This is especially useful for running BASIC programs that require extensive—and slow—computation, combined with long printouts. Basically, spooling takes printer output and stores it back on the disk as a file, at high speed, instead of printing it. At a later time, while running another program whose output is also going on disk, the first program's output can be printed from the disk file at the same time. In this way, the program can continue running at top speed without waiting for the printer, while the printer can run continuously without waiting for the program. Essentially, two things go on at the same time. (The MP-T timer has to be installed in the computer to use the spooling feature.)

There is another use for spooling. It is possible to run a program, store its output on disk, and then examine that output on a CRT terminal before deciding whether to print it or not. This avoids a waste of paper—and time—if a program's results are not exactly what is wanted.

To implement printer spooling, the new FLEX has several new commands. The O command is used to specify that the output of the following program is to go to disk with an .OUT extension. After the output is on the disk, the PRINT command is used to instruct FLEX to put that program in a spooling queue to be printed when its turn comes. The status of programs in the queue can be checked at any time with a QCHEK command. QCHEK can also be used to delete individual files from the queue, or an XOUT command can delete all files that have an .OUT extension.

Printer spooling is a technique commonly used in large computer installations, and this is a first in the microcomputer area. But it also introduces some problems. For instance, if program output is going to a disk, what happens if the disk becomes full? Furthermore, if the program whose output is going on disk also happens to be using the same disk for files, the running time may be appreciably lengthened by the need for the head to move from track to track.

Since the print queue may contain several different files to be printed, there will often be a need to stop the printout between files to change to a different kind of paper, move to the top of a new page or make some other adjustments. Unfortunately, FLEX doesn't appear to have a convenient way of inserting a wait into its queue.

If there is a lot of printing to be done, the disk may be on for a long time during the printing; because of the design of the SWTP controller, the motor will run continuously during an extended print session. During an hour of printing, the disk will make 18,000 revolutions; most disk and drive manufacturers specify disk life as two or three million revolutions, but 18,000 revolutions in one hour is still a large number.

Finally, printer spooling would be a much more valuable feature if there were some provision for a second printer. (Incidentally, it is designed for a parallel printer in port 7, not for the terminal.)

(Percom's INDEX DOS takes another approach. Program output can be routed to the disk, as in the new FLEX, but its printing at a later time cannot be overlapped with other processing; it would have to be handled as a separate job all by itself. This provides the option of examining output before printing, but doesn't save the time that FLEX does. Instead, INDEX allows the printing to be overlapped with the main program itself, by using a buffer area in memory and interrupts to allow the printer to run at the same time as the computer processes data. This is another approach to the problem; FLEX may work out better in some cases, INDEX may be better in others.)

The new FLEX differs from mini FLEX in several other ways. For example, a disk is assigned a name when it is first initialized (though there is no mention in the manual of the name ever being used for anything). Files can be protected from being deleted, renamed or written over, which is an important feature. If you want to keep a file secret, you can also prevent it from being listed in a catalog printout. Some other minor differences are that some disk-resident commands, such as BACKUP, COPYNEW or MEMTEST, don't come with the new FLEX, or that if a file is not found on one of the drives, FLEX will look at the other drive.

What about other software? With mini FLEX, as part of the system purchase price, you get SWTP Disk BASIC Version 3.0. This is essentially SWTP 8K BASIC, which has been modified to work with the disk. The

Listing 1.

```
                        NAM  FLEX-TSC EDITOR
                        OPT  TAP,NOG
                    * ***************************
                    * * FLEX  TSC/EDITOR       *
                    * ***************************
                    * ***** FLEX-FMS FUNCTION CODES *****
0000                IO      EQU  0              CALL FOR I/O
0001                READ    EQU  1              OPEN FOR READ
0002                WRITE   EQU  2              OPEN FOR WRITE
0004                CLOSE   EQU  4              CLOSE FILE
                    * ***** FCB LAYOUT *****
0000                XFC     EQU  0              FCB+0  FUNCTION CODE
0001                XES     EQU  1              FCB+1  ERROR STATUS
0003                XUN     EQU  3              FCB+3  DRIVE NUMBER
0004                XFN     EQU  4              FCB+4-11  FILE NAME
000C                XEN     EQU  12             FCB+12-14  EXTENSION NAME
0001                TXT     EQU  1                    'TXT' FORMAT
003B                XCM     EQU  59             FCB+59  COMPRESS FLAG
0000                XON     EQU  0                    COMPRESSION ON
00FF                XOFF    EQU  $FF                  COMPRESSION OFF
                    * ***** FLEX-FMS ENTRY POINTS *****
7803                FMSCLS  EQU  $7803          FMS CLOSE
7806                FMS     EQU  $7806          FMS CALL
                    * ***** FLEX ROUTINES *****
7103                WARMS   EQU  $7103          FLEX WARM START
7115                INBUFF  EQU  $7115          INPUT DATA INTO LINE BUFFER
7127                GETFIL  EQU  $7127          LOAD FCB FROM LINE BUFFER
712D                SETEXT  EQU  $712D          SET FILE EXTENSION
713C                RPTERR  EQU  $713C          REPORT DISK ERRORS
7118                PSTRNG  EQU  $7118          PRINT STRING END IN $04
711E                PCRLF   EQU  $711E          PRINT CR AND LINE FEED
                    * ***** OPEN FILE FOR READ *****
1491                        ORG  $1491
1491 CE 15 0E       OR      LDX  #FCB           POINT TO OUR FCB
1494 86 01                  LDA  A #READ          CODE FOR OPEN READ
1496 A7 00                  STA  A XFC,X          STORE FUNCTION CODE INTO FCB
1498 BD 78 06               JSR  FMS            CALL FLEX FMS
149B 26 59                  BNE  ERR            BRANCH IF OPEN ERROR
149D 86 00                  LDA  A #IO            CODE FOR I/O PROCESSING
149F A7 00                  STA  A XFC,X          STORE FUNCTION CODE INTO FCB
14A1 39                     RTS
                    * ***** OPEN FILE FOR WRITE *****
14A2 CE 15 0E       OW      LDX  #FCB           POINT TO OUR FCB
14A5 86 02                  LDA  A #WRITE         CODE FOR OPEN WRITE
14A7 A7 00                  STA  A XFC,X          STORE FUNCTION CODE INTO FCB
14A9 BD 78 06               JSR  FMS            CALL FLEX FMS
14AC 26 48                  BNE  ERR            BRANCH IF OPEN ERROR
14AE 86 00                  LDA  A #IO            CODE FOR I/O PROCESSING
14B0 A7 00                  STA  A XFC,X          STORE FUNCTION CODE INTO FCB
14B2 39                     RTS
                    * ***** ASK TERMINAL FOR FILE NAME *****
14B3 BD 71 1E       ASK     JSR  PCRLF          PRINT CR AND LINE FEED
14B6 CE 15 CE               LDX  #ASKMSG        POINT TO OUR ?? MESSAGE
14B9 BD 71 18               JSR  PSTRNG         FLEX STRING OUTPUT RTN
14BC BD 71 15               JSR  INBUFF         INPUT RESPONSE INTO BUFFER
14BF CE 15 0E               LDX  #FCB           POINT TO OUR FCB
14C2 BD 71 27               JSR  GETFIL         LOAD FCB WITH DATA FROM BUFFER
14C5 25 09                  BCS  SERR           BRANCH IF SYNTAX ERROR
14C7 CE 15 0E               LDX  #FCB           POINT TO OUR FCB
14CA 86 01                  LDA  A #TXT           CODE FOR 'TXT'
14CC BD 71 2D               JSR  SETEXT         SET EXTENSION NAME
14CF 39                     RTS
14D0 BD 71 1E       SERR    JSR  PCRLF          PRINT CR AND LINE FEED
14D3 CE 15 D7               LDX  #SYNTAX        POINT TO ERR MSG
14D6 BD 71 18               JSR  PSTRNG         OUTPUT SYNTAX ERR MSG
14D9 20 D8                  BRA  ASK            GO ASK FOR IT AGAIN
                    * ***** READ/WRITE SUBROUTINE *****
14DB FF 15 E5       RW      STX  XSAVE          SAVE X-REG
14DE F7 15 E4               STAB BSAVE          SAVE B-ACCUM
```

SAVE, LOAD and APPEND commands of BASIC allow saving and loading BASIC programs on the disk; cassette commands are now TSAVE, TLOAD and TAPPEND.

In addition, BASIC allows sequential data files on the disk. A disk file is opened with an OPEN command, which ties a BASIC file number with a specific named file on the disk. Subsequent READ, WRITE and RESTORE statements read or write on the file and can reset it to the beginning, in a sequential fashion as if the data were going to tape. When data is done, you close the file. This BASIC does not allow random files, a big limitation to some users.

Having written FLEX, TSC is the biggest force behind other systems and application programs available for it. They have an excellent text editor ($31.50 for the disk version) for preparing text and program files, an assembler ($31.50), a text processor ($40), a debug package ($43), a package of disk utilities ($100), a disk sort-merge package ($75) and even a super-fast BASIC interpreter ($50), which is claimed to be the fastest BASIC on any 8-bit micro yet. But it only has sequential files, not random files.

```
14E1 CE 15 0E          LDX  #FCB          POINT TO OUR FCB
14E4 BD 78 06          JSR  FMS           CALL FLEX FMS
14E7 26 07             BNE  RERR          CHECK FOR I/O ERROR, OR 'EOF'
14E9 FE 15 E5          LDX  XSAVE         RESTORE X-REG
14EC F6 15 E4          LDA  B BSAVE         RESTORE B-ACCUM
14EF 39                RTS
                * ***** COMMON ERROR REPORTER *****
14F0 A6 01      RERR   LDA  A XES,X         RETRIEVE ERROR CODE
14F2 81 08             CMP  A #08           CHECK FOR 'EOF'  CODE=08
14F4 27 09             BEQ  EOF           IF FOUND, EOF-- ELSE ERROR
14F6 BD 71 3C  ERR     JSR  RPTERR        PRINT DISK ERROR CODE
14F9 BD 78 03          JSR  FMSCLS        CLOSE ALL OPEN FILES
14FC 7E 04 41          JMP  EDIT          GO BACK TO EDITOR PROGRAM
0441           EDIT    EQU  $0441         PRINT '?' AND EDITOR PROMPT
                * ***** READ 'EOF' ROUTINE *****
1458           READ25  EQU  $1458         RETURN TO PROCESS READ
1464           READ4   EQU  $1464         EOF HAS BEEN READ
14FF 86 04     EOF     LDA  A #CLOSE        CODE FOR CLOSE FILE
1501 A7 00             STA  A XFC,X         STORE FUNCTION CODE INTO FCB
1503 BD 78 06          JSR  FMS           CALL FLEX FMS
1506 26 EE             BNE  ERR           BRANCH IF ERROR ON CLOSE
1508 FE 15 E5          LDX  XSAVE         RESTORE X-REG
150B 7E 14 64          JMP  READ4         CONTINUE WITH 'EOF' PROCESSING
                * ***** CONSTANTS AND TERMINAL MESSAGES *****
150E           FCB     RMB  192           192 BYTE BLOCK FOR OUR FCB
15CE 46        ASKMSG  FCC  'FILE?  '
15D6 04                FCB  4
15D7 53        SYNTAX  FCC  'SYNTAX ERROR'
15E3 04                FCB  4
15E4           BSAVE   RMB  1             SAVE B-ACCUM
15E5           XSAVE   RMB  2             SAVE X-REG
15E7 0D                FCB  $0D           SET BEGINNING OF EDITOR BUFFER
15E8           BUFFER  EQU  *             USER BUFFER AREA
                * ***** OVERLAY OLD CODE, AND ADD PATCHES *****
020C                   ORG  $020C         I/O VECTORS
020C 7E 14 DB          JMP  RW            READ ROUTINE
020F 7E 14 DB          JMP  RW            WRITE ROUTINE
0212 4F FF             FDB  $4FFF         **** SET MEMORY LIMIT ****
                *
0272                   ORG  $0272         COMMAND TABLE
0272 04 41             FDB  $0441         'GAP' IS NOW INVALID
                *
0358                   ORG  $0358
0358 CE 15 E8          LDX  #BUFFER       POINT TO OUR NEW EDITOR BUFFER
                *
098B                   ORG  $098B         'EXIT' COMMAND
098B 7E 71 03          JMP  WARMS         GO BACK TO FLEX
                *
13D3                   ORG  $13D3         'WRITE' COMMAND
13D3 BD 14 B3          JSR  ASK           ASK FOR OUTPUT FILE NAME
13D6 BD 14 A2          JSR  OW            OPEN FILE FOR OUTPUT
13D9 01                NOP
                *
13F5                   ORG  $13F5         PROCESS WRITE EOF
13F5 CE 15 0E          LDX  #FCB          POINT TO OUR FCB
13F8 86 04             LDA  A #CLOSE        CODE FOR CLOSE FILE
13FA A7 00             STA  A XFC,X         STORE FUNCTION CODE INTO FCB
13FC BD 78 06          JSR  FMS           CALL FLEX FMS
13FF 27 03             BEQ  X2            IF OK, RETURN
1401 7E 14 F6          JMP  ERR             ELSE REPORT ERROR
1404 39        X2      RTS
                *
142D                   ORG  $142D         'READ' COMMAND
142D BD 14 B3          JSR  ASK           ASK FOR INPUT FILE NAME
1430 BD 14 91          JSR  OR            OPEN FILE FOR INPUT
1433 01                NOP
                *
146F                   ORG  $146F         DEVICE CONTROL
146F 01                FCB  1,1,1         3 NOP'S FOR DEVICE CONTROL
                *
                       END
```

The new FLEX 2.0 includes the text editor, assembler, advanced programmer's manual and documentation as part of the price, so that if you plan to purchase these, the improved FLEX package is a better deal. On the other hand, programs that run under mini FLEX require changes to make them run under the new FLEX; in some cases major changes may be needed. Furthermore, the new FLEX price does not include a BASIC interpreter; the new TSC super-fast BASIC in the new FLEX 2.0 form costs $55 (and includes random disk files).

Other FLEX-compatible software is available from Computerware Software Services (830 First Street, Encinitas CA 92024) and includes a PILOT interpreter, and various games and utility programs.

Ed Smith's Software Works (PO Box 339, Redondo Beach CA 90277) also has FLEX software, including a macro-assembler, disassembler, trace/debug package and others. A PILOT interpreter is also available from SWTP.

A BASIC renumbering program for FLEX BASIC version 3.0 is available from Lehigh Computer Works ($10, 1132-2 Tilghman, Allentown PA 18102).

Microware Systems Corp. (PO Box 4865, Des Moines IA 50304) also sells mini FLEX software, including their A/BASIC compiler ($150) and related interpreter and debugging software, a LIST interpreter, as well as a chess program and Eliza, a fascinating computerized psychiatrist program.

Advanced FLEX Programming Example

An example of using FLEX FMS and monitor routines is shown in Listing 1 for those interested in assembly-language programming of disk operations. This listing shows the patches to the cassette version of TSC's text editor, allowing it to run under FLEX (TSC sells a FLEX version of the Text Editor, but this version was adapted by Phil for users who already have the cassette version).

The beginning of the listing shows the entry points into the FLEX routines used, along with information concerning the FCB. The next segments of software show the open file, close file, prompt for file name and common I/O routines. These new segments are added to the editor software and referenced by some patches to the editor pointers. At the end of the listing are the patches that reset the pointers within the editor to reflect the newly added disk software.

A certain sequence of events must take place to properly access a disk file. Before the FCB is opened, it must be loaded with the correct information. The proper file name, with optional extension and drive number, must be set into the FCB. This was done using the FLEX INBUFF routine to accept data from the terminal, placing it in the line buffer. The FLEX routine GETFIL is then used to parse the line and load the FCB with the data that it finds in the line buffer. The SETEXT routine is then used to specify an extension of TXT. The file is now capable of being opened by a call to FMS. After the file is processed, it must be closed by a call to FMS.

Once the file is closed, the FCB may be used for any I/O to any file. In this case, only one FCB is used for both reading and writing of the edit buffer.

SSB DOS-68

Like the SWTP system, the SSB system consists of a cabinet, power supply, controller board, cable, a DOS called DOS-68 and Disk File BASIC. The cabinet and power supply can handle up to three drives, and the system can be bought in one-, two- or three-drive versions.

Like the SWTP disk system, the SSB system also uses soft-sectored disks (though their format is not compatible, and one system cannot read disks made on the other). The controller also uses the 1771-01 floppy disk controller IC, except that the controller in this case is a large board that plugs into the 50-pin bus, like a memory or CPU board. Hence, it does not use up I/O slots.

The hardware design of the controller is quite different from that of the SWTP controller. The SWTP controller relies on a bootstrap program in SWTBUG (which does not always work well the first time); the SSB controller has the bootstrap program and some other I/O routines in a 512-byte ROM on the controller card; so it can also be used with other monitors.

The controller design is interesting in other ways too. In a typical SWTP system, I/O ports 0 through 7 use the 32 addresses from 8000 through 801F. Addresses 8020 through 803F are left unused for those users who want to add a second motherboard to provide eight more I/O ports. But because of incomplete I/O address decoding, the addresses from 8000 through 801F are also decoded as 8040 through 805F, 8080 through 809F and so on, all the way up through 8FFF (or 9FFF in the older motherboard). The SSB controller interleaves its ROM bootstrap and I/O routines into the empty spaces between the I/O ports. That is, there are 32 bytes between 8020 and 802F, another 32 bytes from 8060 through 807F and so on, all the way up to 83FF. This is a novel way to sneak in some ROM into the system without interfering in any way with existing memory or I/O (unless you want to expand to a second motherboard and eight more I/O ports). The bootstrap program starts at address 8020, and so a simple jump to that address boots the disk.

The controller also uses a PIA at addresses 9FFC-9FFF for I/O; hence, you cannot have memory in the 9000-9FFF area, but this is not much of a limitation.

DOS-68 requires 4K of RAM memory at address 7000-7FFF but is available in optional versions that use 4K starting at addresses A000 or D000. A somewhat longer version of DOS-68 that supports random files is also available and requires 6K of memory at 6800-7FFF (optional forms are available at higher addresses).

Like FLEX, DOS-68 maintains a directory on the disk and chains together both used and empty sectors. File space is allocated dynamically, and free or available sectors are allocated as needed, so the disk need not be repacked to combine empty sectors (unless it is desired to speed up the system).

DOS-68 has a set of commands that are part of DOS and always in memory and an additional set of disk-resident commands (called transients) that reside on the disk and are loaded into memory only as needed. These include four memory-resident commands:

CLOSE—close all open disk files.

EXIT—return to the monitor.

GET—load file into memory and return to DOS.

RUN—load file into memory and execute it if applicable.

It also has the following disk-resident commands:

LIST—list the directory of a specified diskette.

SAVE—save a specified region of memory and an optional starting address.

GETH—load disk files created in MIKBUG punch format (S113 . . .) from assembler or patches.

DELETE—remove an entry from the directory and release the space allocated to that file.

RENAME—change the name of a file.

APPEND—combine two files into one.

PRINT—display the contents of a file.

COPY—copy a file from one disk to another.

SDC—single-disk copy for single-disk systems.

LINK—set a pointer to inform the bootstrap program where the DOS is stored on the disk.

INSTAL—rename a user file to a command file.

REMOVE—rename a command file into a user file.

FIND—display the starting and ending memory addresses of a binary program file.

VIEW—display a text file, adding cursor control as needed.

FORMAT—initialize a blank cassette.

ASYS—assign a system diskette location.

BASIC6—start the BASIC interpreter.

The SSB disk system comes with a Disk File BASIC. The interesting point is that, although Smoke Signal Broadcasting doesn't say so, this is Computerware Software Services' Super BASIC. It has every feature that we have gotten used to with SWTP cassette BASICs, plus a few new ones: a STRING command allows the string length to be changed; HOME issues a home-up and erase command for CRT terminals; SKIP skips lines on the terminal; WAIT inserts a time delay; RJUST allows neater printout of columns of figures by allowing decimal points to be lined up.

The BASIC disk commands include FLIST for listing the files on the disk, FDEL for deleting a file, FREN for renaming a file, SAVE, LOAD and APPEND for saving and loading programs on the disk and CHAIN for having one BASIC program call another. It also supports sequential disk files (which has caused confusion among some readers who thought, based on SSB advertising, that random files were also supported).

File commands include OPEN and CLOSE, READ and WRITE, RESTORE (for resetting a file

Listing 2.

```
                        NAM  SSB-TSC EDITOR
                        OPT  TAP,NOG
                    * ********************************
                    * * SMOKE SIGNAL  TSC/EDITOR    *
                    * ********************************
                    * ***** SSB-DFM FUNCTION CODES *****
0001                QS04W  EQU  1              OPEN FOR WRITE
0002                QSWRIT EQU  2              WRITE DATA
0003                QSWC   EQU  3              CLOSE FILE FOR WRITING
0004                QS04R  EQU  4              OPEN FOR READ
0005                QSREAD EQU  5              READ DATA
0006                QSRC   EQU  6              CLOSE FILE FOR READING
                    * ***** FCB LAYOUT *****
0000                XFC    EQU  0              FCB+0  FUNCTION CODE
0001                XES    EQU  1              FCB+1  ERROR STATUS RETURNED TO USER
0002                XUN    EQU  2              FCB+2  UNIT NUMBER
0003                XFN    EQU  3              FCB+3  FILE NAME
0009                XEN    EQU  9              FCB+9  EXTENSION NAME
000C                XFT    EQU  12             FCB+12 FILE TYPE
                    * ***** SSB-DFM ENTRY POINTS *****
7780                ODFM   EQU  $7780          INIT OF DFM
7783                CDFM   EQU  $7783          SSB-DOS CLOSE ALL FILES
7786                DFM    EQU  $7786          SSB-DISC FILE MANAGER
7283                ZWARMS EQU  $7283          SSB-DOS WARM START
72B5                ZLINEI EQU  $72B5          SSB-INPUT STRING INTO LINE BUFFER
7291                ZFLSPC EQU  $7291          LOAD FCB FROM LINE BUFFER
72A9                ZTYPDE EQU  $72A9          TYPE OUT ERROR MESSAGE
                    * ***** MIKBUG ENTRY POINTS *****
E07E                PDATA1 EQU  $E07E          MIKBUG PRINT STRING ROUTINE
                    * ***** OPEN FILE FOR READ *****
1491                       ORG  $1491
1491 CE 15 14       OR     LDX  #FCB           POINT TO OUR FCB
1494 86 04                 LDA  A #QS04R         CODE FOR OPEN SEQUENTIAL READ
1496 A7 00                 STA  A XFC,X          STORE FUNCTION CODE INTO FCB
1498 BD 77 86              JSR  DFM            CALL SSB-DFM
149B 26 52                 BNE  ERR            BRANCH IF OPEN ERROR
149D 86 05                 LDA  A #QSREAD        CODE FOR READ SEQUENTIAL
149F A7 00                 STA  A XFC,X          STORE FUNCTION CODE INTO FCB
14A1 39                    RTS
                    * ***** OPEN FILE FOR WRITE *****
14A2 CE 15 14       OW     LDX  #FCB           POINT TO OUR FCB
14A5 86 01                 LDA  A #QS04W         CODE FOR OPEN SEQUENTIAL WRITE
14A7 A7 00                 STA  A XFC,X          STORE FUNCTION CODE INTO FCB
14A9 BD 77 86              JSR  DFM            CALL SSB-DFM
14AC 26 41                 BNE  ERR            BRANCH IF OPEN ERROR
14AE 86 02                 LDA  A #QSWRIT        CODE FOR WRITE SEQUENTIAL
14B0 A7 00                 STA  A XFC,X          STORE FUNCTION CODE INTO FCB
14B2 39                    RTS
                    * ***** ASK TERMINAL FOR FILE NAME *****
14B3 CE 15 BA       ASK    LDX  #ASKMSG        POINT TO "NAME?" MESSAGE
14B6 BD E0 7E              JSR  PDATA1         MIKBUG OUTPUT STRING ROUTINE
14B9 BD 72 B5              JSR  ZLINEI         INPUT STRING INTO SSB LINE BUFFER
14BC CE 15 14              LDX  #FCB           POINT TO OUR FCB
14BF BD 72 91              JSR  ZFLSPC         LOAD FCB WITH INFO FROM LINE BUFFER
14C2 25 0E                 BCS  SERR           SYNTAX ERROR WAS FOUND
14C4 CE 15 14              LDX  #FCB           POINT TO OUR FCB
14C7 86 54                 LDA  A #'T            ADD 'TXT' EXTENSION
14C9 A7 09                 STA  A XEN,X          -
14CB A7 0B                 STA  A XEN+2,X        -
14CD 86 58                 LDA  A #'X            -
14CF A7 0A                 STA  A XEN+1,X        -
14D1 39                    RTS
14D2 CE 15 CA       SERR   LDX  #SYNTAX        POINT TO ERR MSG
14D5 BD E0 7E              JSR  PDATA1         MIKBUG OUTPUT STRING ROUTINE
14D8 20 D9                 BRA  ASK            GO ASK GUY AGAIN
                    * ***** READ/WRITE SUBROUTINE *****
14DA FF 15 DD       RW     STX  XSAVE          SAVE X-REG
14DD F7 15 DC              STA  B BSAVE          SAVE B-ACCUM
14E0 CE 15 14              LDX  #FCB           POINT TO OUR FCB
14E3 BD 77 86              JSR  DFM            CALL SSB-DFM TO READ/WRITE
14E6 26 07                 BNE  ERR            IF ERROR, GO REPORT IT
14E8 FE 15 DD              LDX  XSAVE          RESTORE X-REG
14EB F6 15 DC              LDA  B BSAVE          RESTORE B-ACCUM
```

back to the beginning), SCRATCH (for erasing a data file) and STATUS (for testing if any errors occurred during a file access).

SSB offers a number of other programs for their disk system. This includes the SE-1 Super Editor ($29), the SA-1 Super Assembler ($29), TP-1 Text Processor ($40), TD-1-D Trace-Disassembler ($26) and the SG-1-D Source Generator ($31). They also have a full FORTRAN compiler ($99).

Also available are a user's library disk ($20) containing additional transient commands and an SD-2 BASIC compiler ($325). The text editor, processor and assembler are written by TSC and, except for the way they use the disk and are loaded and started, are identical to the software available for the SWTP MF-68 disk. The BASIC compiler is written by Software Dynamics.

Other software is available from Ed Smith's Software Works; some SSB software comes from Ed Smith's.

Next to SSB, the most prolific supplier of DOS-68 compatible software appears to be Computerware Software Services. Their Random-Access Disk File BASIC ($90) supports not only sequential files, but also indexed sequential or true random-access disk files, where file entries can be changed without rewriting the entire file. This powerful BASIC interpreter is faster than standard SWTP BASICs. (There is a good chance that this BASIC will be offered by SSB as well during 1979.)

Computerware also offers a Disk Check File Maintenance system ($50), a Disk Mailing List system, several disks with transient commands, a BASIC renumberer program called RENBAS and various other disk-based programs.

Microware also offers SSB versions of the same software they offer for mini FLEX.

```
14EE 39              RTS
                     * ***** COMMON ERROR REPORTER *****
14EF BD 72 A9 ERR    JSR  ZTYPDE        PRINT DISC ERROR CODE
14F2 BD 77 83        JSR  CDFM          CLOSE ALL OPEN FILES
14F5 7E 04 41        JMP  EDIT          GO BACK TO MAIN PROGRAM
                     * ***** INPUT 'EOF' ROUTINE *****
1458                 READ25 EQU  $1458  RETURN TO PROCESS READ
1464                 READ4  EQU  $1464  READ EOF
14F8 81 1A           EOF    CMP  A #$1A   TEST FOR 'EOF' CHAR
14FA 27 03           BEQ  X1            EOF HAS BEEN FOUND
14FC 7E 14 58        JMP  READ25        IF NOT, RETURN
14FF FF 15 DD X1     STX  XSAVE         SAVE X-REG BUFFER POINTER
1502 CE 15 14        LDX  #FCB          POINT TO OUR FCB
1505 86 06           LDA  A #QSRC         CODE FOR CLOSE READ SEQUENTIAL
1507 A7 00           STA  A XFC,X         STORE ITFUNCTION CODE INTO FCB
1509 BD 77 86        JSR  DFM           CALL SSB-DFM
150C 26 E1           BNE  ERR
150E FE 15 DD        LDX  XSAVE         RELOAD X-REG
1511 7E 14 64        JMP  READ4         CONTINUE WITH 'EOF' PROCESSING
                     * ***** CONSTANTS AND TERMINAL MESSAGES *****
1514                 FCB  RMB  166      166 BYTE BLOCK FOR OUR FCB
0441                 EDIT EQU  $0441    PRINT '?' AND EDIT PROMPT
15BA 0D              ASKMSG FCB  $D,$A,0,0,0,0,0
15C1 46                     FCC  'FILE:  '
15C9 04                     FCB  4
15CA 0D              SYNTAX FCB  $D,$A,0,0,0,0,0
15D1 53                     FCC  'SYNTAX ERR'
15DB 04                     FCB  4
15DC                 BSAVE  RMB  1      SAVE B-ACCUM
15DD                 XSAVE  RMB  2      SAVE X-REG
15DF 0D                     FCB  $0D   SET BEGINNING OF BUFFER
15E0                 BUFFER EQU  *      EDIT BUFFER MARKER
                     * ***** OVERLAY OLD CODE, AND ADD PATCHES *****
020C                        ORG  $020C  I/O VECTORS
020C 7E 14 DA               JMP  RW     READ ROUTINE
020F 7E 14 DA               JMP  RW     WRITE ROUTINE
0212 4F FF                  FDB  $4FFF  ****** SET MEMORY TO BE USED
                     *
0272                        ORG  $0272  COMMAND TABLE
0272 04 41                  FDB  $0441  GAP IS NOW INVALID
                     *
0358                        ORG  $0358
0358 CE 15 E0               LDX  #BUFFER  POINT TO BEGINNING OF USABLE MEMORY
                     *
098B                        ORG  $098B  EXIT COMMAND
098B 7E 72 83               JMP  ZWARMS GO BACK TO SSB DOS
                     *
13D3                        ORG  $13D3  WRITE COMMAND
13D3 BD 14 B3               JSR  ASK    ASK FOR OUTPUT FILE NAME
13D6 BD 14 A2               JSR  OW     OPEN FILE FOR OUTPUT
13D9 01                     NOP
                     *
13FA                        ORG  $13FA  WRITE EOF
13FA CE 15 14               LDX  #FCB   POINT TO OUR FCB
13FD 86 03                  LDA  A #QSWC  CODE FOR CLOSE WRITE SEQUENTIAL
13FF A7 00                  STA  A XFC,X  STORE FUNCTION CODE INTO FCB
1401 BD 77 86               JSR  DFM    CALL SSB-DFM
1404 27 03                  BEQ  X2     IF OK, RETURN
1406 7E 14 EF               JMP  ERR    IF NOT, REPORT ERROR
1409 39              X2     RTS
                     *
142D                        ORG  $142D  READ COMMAND
142D BD 14 B3               JSR  ASK    ASK FOR INPUT FILE NAME
1430 BD 14 91               JSR  OR     OPEN FILE FOR INPUT
1433 01                     NOP
                     *
1454                        ORG  $1454  READ EOF
1454 7E 14 F8               JMP  EOF    GO TEST FOR EOF
                     *
146F                        ORG  $146F  DEVICE CONTROL CHARACTERS
146F 01                     NOP
1470 01                     NOP  NOP OUTPUT OF TURN-OFF CHAR
1471 01                     NOP
                     *
                            END
```

Advanced DOS-68 Programming Example

Most users will probably use the supplied software and program mostly in BASIC, but the system can also be used in assembly-language programs. The DOS-68 manual has a completely different orientation than SWTP/TSC's FLEX manual. Whereas the FLEX manual is written for the casual user and is supplemented by an advanced programmer's manual, the SSB DOS-68 manual is much more detailed and also lists the information needed by advanced programmers.

The diskette is maintained by a disk-file-management set of routines. They are accessed via a jump table that supplies entry points for various file-handling functions. These include opening and closing files, reading, writing and several other special I/O requests.

Like the SWTP disk, all file functions are channeled through a user-created work area called File Control Block (FCB). An FCB is required for each active file the user is accessing. This area acts as an interface to DFM to communicate the user's request for I/O. The DFM routines, in turn, use it as a buffer to hold data, letting the user access a character at a time. Several routines are available in the DOS Monitor to assist the user in correctly loading the FCB with the needed information.

The standard DOS supports sequential processing, and the expanded DOS adds random accessing as well. Space compression may be requested for certain text files, along with other special processing techniques.

An example of using the Smoke Signal DFM routines is shown in Listing 2. This listing shows the patches to the cassette version of the TSC Text Editor to run on an SSB disk system.

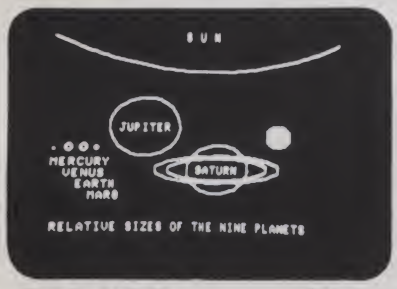
The beginning of the listing shows the entry points into the DFM routines, along with those of MIKBUG that are used. In addition, some offsets into the FCB are defined for later usage. The next segments of software reflect the disk routines to open a file, close a file, prompt the user for a file name and perform other common I/O. These newly added segments are referenced by some patches to the editor code. At the end of the listing are the patches that reset the pointers within the editor to reflect the new disk software.

This listing is similar to that of the FLEX patches. There are a few differences, mainly in the FCB offsets and in entry point addresses. The ZLINEI routine is used to accept data from the terminal and store it into the line buffer. The monitor routine ZFLSPC is used to parse through the buffer and load the FCB with the proper information. The extension must be loaded by hand, as there is no routine to perform this function. In addition, the files are stored as memory image binary, rather than compressed ASCII.

As you can see, though the DOS-68 and FLEX systems are different, they are set up in similar ways. Thus, any software created for one system should be fairly easily modified for the other.

Next month, we will examine the features of the Percom LFD-400 disk system and conclude this two-part article by weighing the advantages and disadvantages of each of the three systems. ■

Software for the APPLE II



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FORMAT

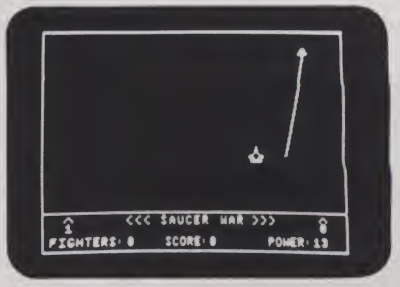
PROGRAMMA's FORMAT (Version 1.0) is a command oriented text processor designed to be fully compatible with PIE (PROGRAMMA Improved Editor).

FORMAT's system of imbedded commands (within the text) give it an ease of operation similar to text formatters found on some mini-computers.

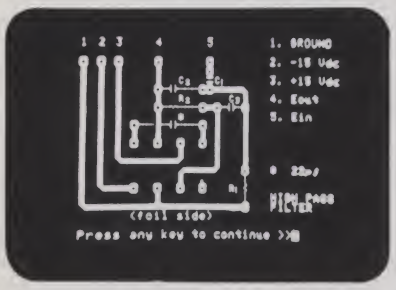
FORMAT features right margin justification, centering, page numbering, anda auto-paragraph indent.

The following commands are available with FORMAT:

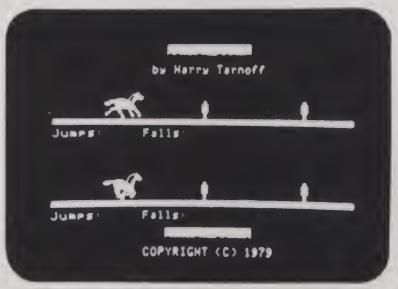
.ad		Begin adjusting right margins
.bp	n	Begin page numbered n
.br		Cause a line break
.ce	n	Center next n lines without fill
.fi		Start filling output lines
.fo	t	Foot title becomes t
.he	t	Head title becomes t
.in	n	Indent n spaces from left margin
.li	n	Literal, next n lines are text
.ll	n	Line length including indent is n
.ls	n	Set line spacing to n
.ml	n	Top spacing including head title
.m2	n	Spacing after heading title
.m3	n	Spacing before foot title
.m4	n	Bottom spacing including foot title
.na		Stop adjusting right margins
.nf		Stop filling output lines
.pl	n	Page length is n lines
.pp	n	Begin paragraph= .sp, .fi, .ti n
.sp	n	Space down n lines, except at top
.ti	n	Temporary indent of n
.ul	n	Underline next n input lines



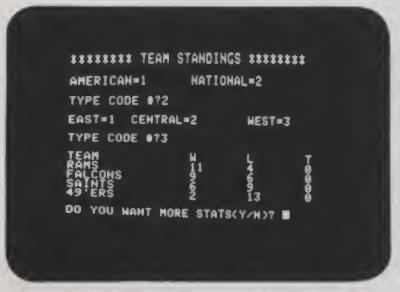
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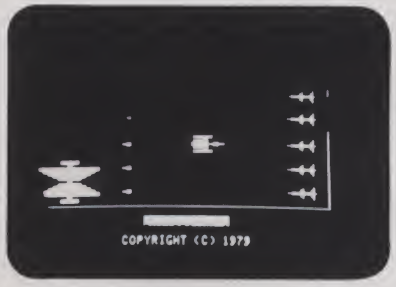
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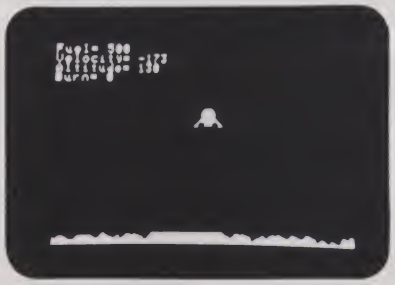
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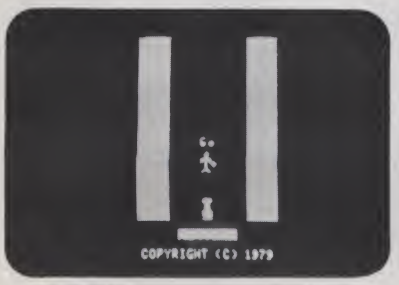


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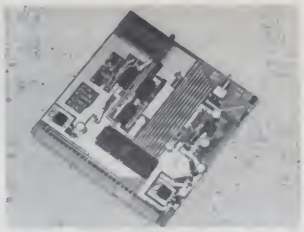
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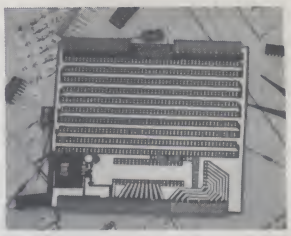
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PAIA 8700 Revisited

Back in August 1979 (p. 94), Rod presented an overview of an under-200 computer, the PAIA 8700. This time, he's going to cover a specific application for the 8700: making music.

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PO Box 73
Tombstone AZ 85638

In a recent article describing the PAIA 8700 computer, August 1979, p. 94, I touched on its physical characteristics, operating techniques and some possible uses. In this article I'll explore one particular application.

Computer music seems to be a popular subject. I received more phone calls and letters as the result of my computer music article ("Music, Music and More Music," *Kilobaud*, November 1978, p. 82) than anything else I've ever written. Therefore, the first thing I tried to do with the 8700 was make some music.

Generating Computer Music

There are two general methods of generating music with a computer. First, the processor can switch one of its external leads on and off at an audio rate. When amplified, this is sound; if done right, it is also music. The second way is to use the computer to control an electronic organ or a synthesizer of some kind.

The late, great "Music System" from Software Technology is an example of the first method. It has the advantage that it is easy to use and that no external hardware other than an amplifier is required. In fact, when not much volume was needed, I drove a small speaker directly with TTL logic. The disadvantage of this method is the limited control of the type of sound produced. On the other hand, using the computer to control an organ or a synthesizer allows you much more freedom of expression. After some experimentation I decided on this second method.

Since I didn't have a synthesizer, I first had to build one. I ordered the Top Octave Experimenter's kit from PAIA to use as a starting point (see Table 1). I also sent for the cassette interface option kit and enough RAM to fill up the board. The 8700 comes with 512 bytes of RAM with space on the board for another 512 bytes for a total of 1024. This RAM is addressed from 0 to 03FF hex.

I quickly installed the cassette kit, which worked the first time. A bonus of the cassette option is a solid-state sounder that beeps whenever a key is touched. It also allows you to hear the recording and playback of your programs. Doubling RAM to 1K required installing four IC sockets and four 2112s ICs.

The top octave kit contains a small PC board, a 4001 CMOS IC and a Mostek 50240 top octave generator. The latter is actually a divider that puts out 13 tones derived from a common clock frequency. If one of the 13 tones is on frequency then all of them have to be right. Using a 2.00024 MHz clock, you can produce the top keyboard octave.

Fig. 1 is a pin-out drawing and block diagram of the 50240. You can change the clock fre-

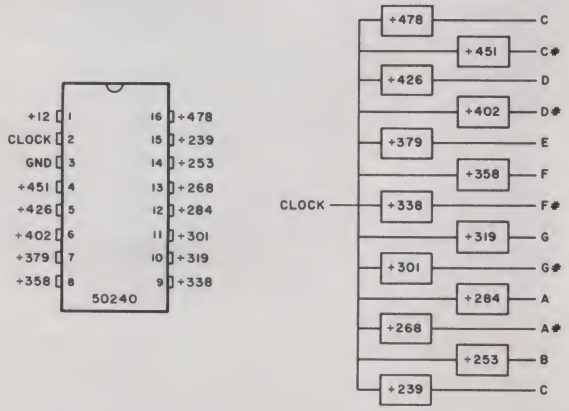


Fig. 1. A pin-out drawing and a block diagram of the Mostek 50240 top octave generator. Inputs are +12 volts, ground and a clock. Outputs are 13 equally tempered semi-notes making up one octave plus one note.

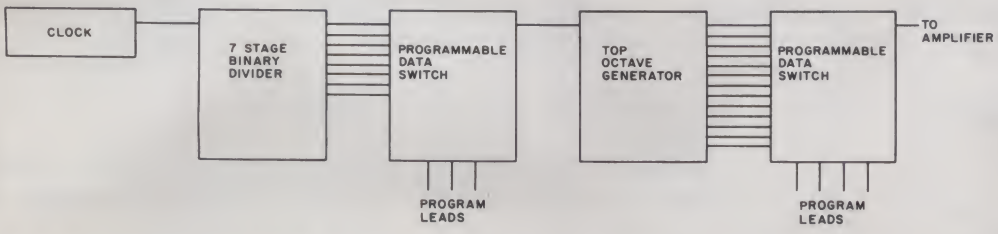


Fig. 2. The block diagram of an effective music generator. The program leads could go to a switch console or a piano-type keyboard, but the real intent is to interface them with a computer output port.

quency to suit your requirements. With a 2.00024 MHz clock and a string of binary dividers any note on a piano or organ keyboard can be produced. Running these notes into various synthesizer modules will allow you to come up with any sound desired.

Fig. 2 is a block diagram showing how a piano keyboard could be reproduced. This simple but sophisticated system is described in "Try Computer Composition" by Kenny Winograd (July 1977 *Kilobaud*, p. 102).

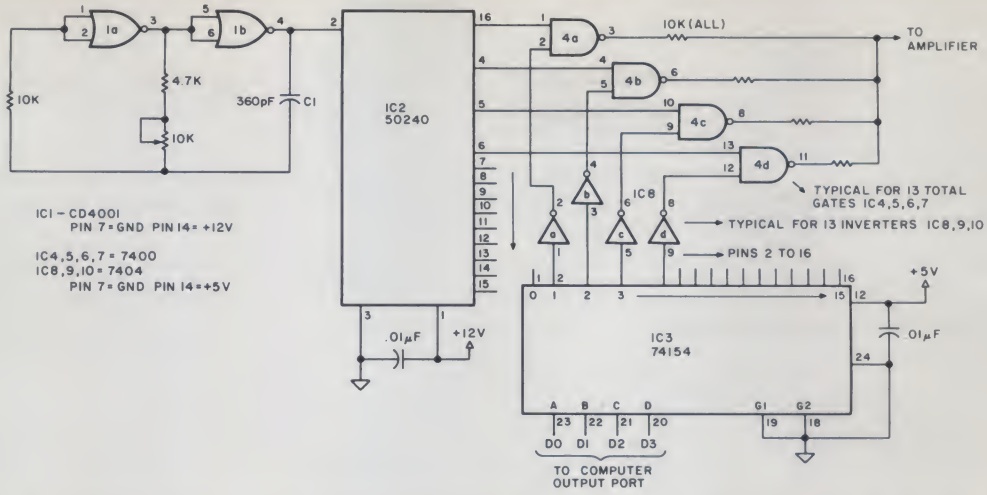


Fig. 3. Schematic of a simple computer-controlled music generator. The TTL ICs could be replaced with CMOS.

Hardware

For experimentation purposes I put together the simple circuit of Fig. 3. The 4001 and the 50240 go on the PC board that comes with the Top Octave Experimenter's kit, but the rest of the ICs must be mounted in some other fashion. In my case they went onto my IC breadboard.

Two of the gates of the 4001 (IC1) are used as an oscillator with the 10k pot for frequency adjustment. A frequency of 224,960 Hz fed from the oscillator to the clock input of the top octave generator (IC2) will result in the middle octave of a piano with A at 440 Hz. Changing the value of C1 will move the range of the oscillator. A smaller value will increase the frequency and vice versa.

With C1 equal to 360 pf (two 180 pf disk capacitors in parallel), the 13 semitones of the middle keyboard octave are present at the output leads of the 50240. It is just a question of feeding the desired tone to the amplifier. The various 7400 gates (ICs 4, 5 and 6) are used to switch one tone at a time to the common output point. The actual selection is determined by the condition of the four data leads (D0, D1, D2 and D3) from the computer output port.

The 74154 (IC3) is a four-line-to-16-line decoder. If the binary code on lines A, B, C and D is zero (see Table 2), then all output lines will be high except 0. If the binary code is 1, then all lines except 1 will be high. Thus it is possible to control up to 16 notes.

An inverter (ICs 8, 9 and 10) is inverted in each output line from the 74154 to satisfy the requirements of the 7400 gates. Since the signal we want to pass is positive-going, it will only pass through the gate when the control lead is also high (see Table 3). The output of the 7400 will be inverted, but this does not present a problem.

I used a combination of TTL and CMOS IC logic because that is what I had available. You could replace the TTL ICs with their CMOS equivalents. This would not only cut way down on the current requirements but

Leads				Output	Lead	Value	
D	C	B	A	LOW		H	L
L	L	L	L	0	A	1	0
L	L	L	H	1	B	2	0
L	L	H	L	2	C	4	0
L	L	H	H	3	D	8	0
L	H	L	L	4			
L	H	L	H	5			
L	H	H	L	6			
L	H	H	H	7			
H	L	L	L	8			
H	L	L	H	9			
H	L	H	L	10			
H	L	H	H	11			
H	H	L	L	12			
H	H	L	H	13			
H	H	H	L	14			
H	H	H	H	15			

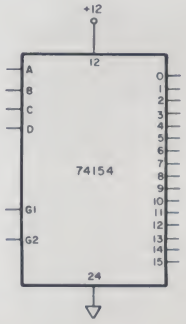


Table 2. Truth table for the 74154 four-line-to-16-line decoder. G1 and G2 must be held low at all times or all output leads will stay high no matter what the condition of A, B, C or D is. Only one output lead can be low at any one time. Leads A, B, C and D are coded in binary coded decimal (BCD). The leads have the value shown on the right. The values of all of the leads in an H (high) condition are added together to get the equivalent decimal value. For instance, if A and C are high then the decimal value is 5.

PAIA 8700 Computer/Controller Kit		$149.95
Cassette Interface Option Kit		22.50
Power Supply Kit		24.95
Top Octave Experimenter's Kit		14.95

Write to PAIA Electronics, Inc., PO Box 14359, Oklahoma City OK 73114, for their complete catalog of computer and music-synthesizer products.

Table 1.

Lead		Output	NAND Gate
A	B	C	
L	L	H	
L	H	H	
H	L	H	
H	H	L	

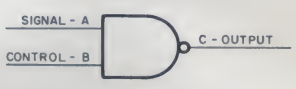


Table 3. If the control lead (B) is held low, the output will never change no matter what the signal lead (A) does. If the control lead B is held high, then the output will change as the signal does, but it will always be inverted by the 7400 NAND gate.

Address	Label	Op Codes	Mnemonics	Comments
0020	LOOP	20 00 FF	JSR KEYBOARD	CALL KEYBOARD SUBROUTINE
0023		B0 FB	BCC LOOP	LOOP IS NOT NEW KEY
0025		8D 20 A8	STA DISPLAY	STORE KEY IN DISPLAY
0028		4C 20 00	JMP LOOP	GET ANOTHER KEY

Program A. A 6502 assembly-language program that will cause the digital display of the 8700 to show the key number of each key as it is pressed. Changing 20 to 40 at location 0026 will allow the computer keyboard to control the music generator in Fig. 3.

Address	Label	Op Codes	Mnemonics	Comments
0020	LOOP	20 00 FF	JSR KEYBOARD	CALL KEYBOARD SUBROUTINE
0023		B0 02	BCC OUT	GO TO OUT IF NEW KEY
0025		A9 00	LDA NOTONE	CLEAR A REGISTER
0027	OUT	8D 40 A8	STA MUSIC	OUTPUT TO MUSIC
002A		4C 20 00	JMP LOOP	CHECK KEYBOARD AGAIN

Program B. A slight modification of Program A disables the tone when a key is not being pressed by putting out 0 (no tone) when the keyboard subroutine returns with the carry set (no new key).

would also eliminate the need for the +5 volt supply since the whole thing could run on +12 volts.

The 7400s could be replaced by 74C00s or 4011s, the 7404s by 74C04s or 4069s, and the 74154 by 74C154 or 4515. You could also use 4514 in place of the 74154, in which case the inverters (ICs 8, 9 and 10) would not be needed since the output leads of the 4514 are already inverted.

The 74C00 and 4000 series ICs are not pin-for-pin compatible with their 7400 counterparts and are generally more expensive than TTL. Motorola identifies their CMOS products with the prefix MC1. Thus the 4011 would be MC14011. Other manufacturers prefix the device number with CD—thus CD4011.

Without connecting Fig. 3 to the computer, you can test the circuit by grounding one or more of the data leads. In fact, for a simple piano you could remove the 74154 and connect its output leads directly to a group of switches (Fig. 4), eliminating the computer completely. However, if this is possible why do we even need the computer?

Yes, you can play this like a piano with the switches in Fig. 4, but if you are not a musician, the result may be unpleasant to listen to. By storing the notes of a composition in memory, you can let the computer keep track of the timing and play them for you. The tempo can easily be changed, and you can save the music code on tape in order to play it again another time.

The Winograd article mentioned previously does a good job of covering both hardware and software, so I won't try to go into too much detail here. However, let's see how the 8700 can be used to control the top octave generator.

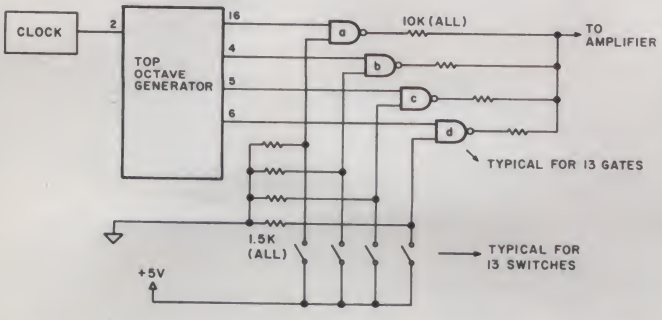


Fig. 4. A 13-note keyboard. More than one note can be played at a time in this configuration.

Software

The 8700 Piebug monitor (in ROM) has a subroutine at FF00 that scans the keyboard, and when it finds a key depressed, it returns with the number of the key in the A register. It also clears the carry flag if this is a new key since the last scan.

Program A is a simple 6502 assembly-language program that reads the computer keyboard and sends what it sees to the digital display. It does this by calling the keyboard subroutine, checking to see if it is a new key, and if it is, it stores the key number at A820 hex, which is the address of the digital display. As you press each key, its number appears on the display.

The parallel output port address is A840 hex, and if we change the 20 hex to 40 hex at location 0026 in Program A, then the key number will be sent to the output port instead of to the digital display. With our little music board connected to the lowest four bits of the output port, we can control the notes from the computer keyboard.

One disadvantage of Program A is that a note will continue to sound until a new key is pressed because the 7800 output port is a latched port that will hold its present value until it receives a new value. Program B takes care of that by shutting off the tone, except while a key is actually being pressed. It does this by sending a 0 to the output port between notes.

A 0 from the keyboard will shut off the music since none of the gates are connected to the 0 lead of the 74154. Keys 1 through D will play the 13 notes of our scale (see Table 4). This is exactly like a piano keyboard, but as I've mentioned it is better and more fun to teach the computer to play for us. This is accomplished by storing notes in memory and then feeding them to the music board along with the proper timing for each note.

Using the techniques presented in Winograd's article, you can put together an inexpensive but sophisticated music-generating system. The 8080 software in that article would have to be rewritten in 6502 assembly language, but it is a simple program and shouldn't present any problems.

Conclusion

These same methods could also be used to control other devices. In fact, anything that can be turned on or off or adjusted electrically is a candidate for computer control, which is what the PAIA 8700 was designed for.

Computer music is an enjoyable subject for software and hardware experimentation. It also satisfies the urge to do something creative with your personal computer. When friends ask if your computer can do anything besides play games, it is great fun to pop in a music cassette and let it play a tune for them. ■

Key	Note	Key	Note
0	NONE	7	F#
1	C	8	G
2	C#	9	G#
3	D	A	A
4	D#	B	A#
5	E	C	B
6	F	D	C

Table 4. List of the notes that correspond with the first 14 keys on the 8700 keyboard.

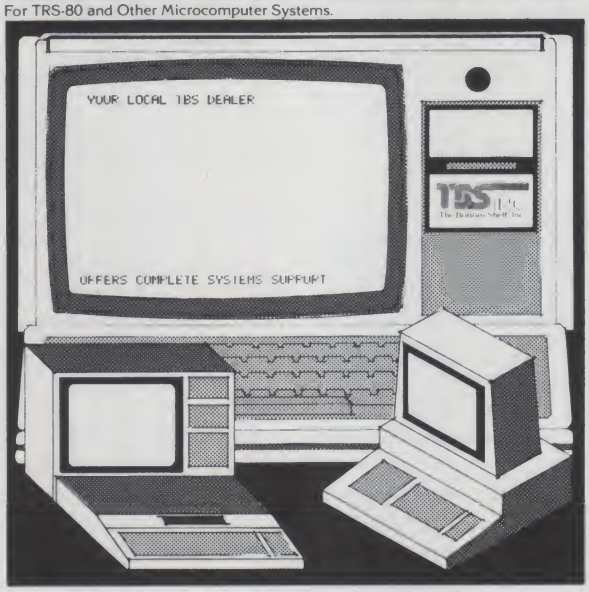
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Level-II Index
Random Ramblings

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Reader Service—see page 227

An Inexpensive TRS-80 Printer Interface

Why spend $300? Try Small System Hardware's $49.95 alternative.

Sherman P. Wantz
424 NW Lakeview Drive
Sebring FL 33870

If you own a "bare-bones" TRS-80 microcomputer system, you will eventually want to buy Radio Shack's $300 expansion interface to provide you with additional memory space, a floppy disk capability, an RS-232 serial port and a parallel port to feed a fast line printer. But suppose you have a printer and would like to connect it to your TRS-80 but can't see your way clear at the moment to spend $300?

That oversimplified scenario described my condition before I read the ad in *Microcomputing* about Small System Hardware's TRS-232 printer interface unit. I learned that for a modest investment I could give my TRS-80 a hard-copy capability, thereby satisfying at least a part of the advantage I had hoped to achieve by buying Radio Shack's expansion interface.

In response to the inquiry I mailed, using *Microcomputing*'s Reader Service card, Small System Hardware sent me a brochure that described its TRS-232 in detail. The brochure convinced me that the TRS-232 was what I needed to connect my TRS-80 microcomputer to my ASR-33 teleprinter so that I could use my Level II BASIC's LLIST and LPRINT commands.

Hardware

The assembled and tested TRS-232 interface unit arrived at my home about three weeks after I had mailed my check for $51.95 ($49.95 for the unit plus $2 to cover shipping and handling) to Small System Hardware, PO Box 366, Newbury Park CA 91320.

The TRS-232 consists of three parts: a 1 × 2 × 3 inch box containing a 741 op amp IC, a transistor, five diodes, resistors and capacitors—all mounted on a small circuit board; a cassette tape that contains a program written in Level II BASIC; and a ten-page booklet that includes instructions, a schematic diagram of the unit, a program listing in BASIC and an assembly-language source listing.

As the instruction booklet explains, the TRS-232 obtains its signal via the gray cord that normally connects the TRS-80 computer to the auxiliary jack of the tape recorder. To use the printer, you must remove the miniature plug covered by a gray sleeve from the recorder's auxiliary jack and plug it into either of the two jacks that are mounted at each end of the interface unit's case. The jacks are connected in parallel so it makes no difference which one you use.

If you should want to use the tape recorder to dump (CSAVE) a program in memory to tape, you must remove the miniature gray plug from the TRS-232 jack and reinsert it in the recorder's auxiliary jack.

I soon discovered that the connect/disconnect procedure was too easy to forget. Therefore, I followed the manufacturer's advice and built a patch cord from audio cable, which I terminated at both ends with miniature plugs (Radio Shack catalog number 274-286). I installed the patch cord permanently between the TRS-232 and the recorder's auxiliary jack (see Fig. 1) and can now print or record programs without bothering to connect or disconnect signal cords.

Power for the interface components is obtained through a line-cord connection that plugs into any 115 volt wall outlet. The TRS-232 contains no off-on switch. It is on when it is plugged into the wall outlet.

The line-cord plug houses a small transformer. Current drain through the transformer is so small that the housing barely feels warm to the touch.

The output signal produced by the interface unit is fed to the printer via a 25-pin BD-25 female connector that is mounted along one edge of the TRS-232's case.

Since the manufacturer assumes that your printer is equipped with a BD-25 male connector, he provides none. I bought the appropriate male BD-25 connector for $2 at the Orlando hamfest flea market. New connectors, some complete with cable, are advertised regularly by suppliers whose ads appear in this magazine.

Only two signal connections had to be made to the BD-25 plug to tie the interface unit to my teleprinter. Pin 9 provided −12 volts dc, and pin 10 provided +12 volts dc. These connections supplied the 20 mA loop current needed to operate the ASR-33 Teletype. Consult your teleprinter manual for appropriate connection points to be made on your machine's terminal board.

The pins of the BD-25 female socket mounted on the TRS-232 are not numbered. Fortunately, however, those pins on the matching male connector are numbered; this helped me to make the correct coupling between the interface unit and my teleprinter.

If your printer does not require 20 mA of driving current—as does my machine—your output signal connections to the interface unit will differ from those I have just described. Small System Hardware claims to have used their interface unit to drive RS-232 compatible printers of all types. RS-232 is the specification number that was given by the Electronic Industries Association to standardize voltage and impedance levels for transmission of digital data.

Please note that the TRS-232 interface unit provides a "receive only" one-way printer capability, so don't expect it to

permit you to use your printer's keyboard to send characters to your computer.

Software

Once you have your interface hardware installed between your TRS-80 and your printer, you will be ready to load (transfer from cassette tape to computer memory) the Level II BASIC program that is supplied with the TRS-232. This program converts parallel data into serial form to operate your printer.

When you apply power to your Level II BASIC microcomputer, the words "MEMORY SIZE?" appear on your video monitor's screen. When these words appear, you will be expected to respond appropriately to reserve memory space for the TRS-232 print function program.

If your system contains 4K bytes of memory, you should type "20360" to reserve space for the 110 bytes required by the program; if your machine contains 16K bytes of memory, you should type "32650." Press the Enter key. Now you are ready to CLOAD the 52-line TRS-232 Level II BASIC program from cassette tape into computer memory.

My program loaded without problem at a volume setting of "4" on my CTR-33 recorder. For those who use the CTR-41 recorder, the manufacturer recommends a volume setting of about "6." After the program has loaded, type "RUN" and press the Enter key.

In succession, the program will ask four questions. Your answers to three of the questions will configure the program to operate with your particular printer. Your response to the questions will: reconfirm the amount of memory space you reserved for the program when you turned your system "on"; specify the baud rate at which your printer operates; declare whether or not a line-feed signal must be sent to the printer following each carriage return; and specify the number of nulls your printer requires (if any) after each carriage return. Once you have answered these four questions, the BASIC program "pokes" your answers—using machine language—into reserved memory.

To test the operation of the printer interface hookup, turn your printer's motor on, type LLIST on your TRS-80 keyboard and press the Enter key. You should see the TRS-232 BASIC program that you just loaded into memory being transferred from computer memory to your printer.

Since the TRS-232 BASIC program has served its purpose after it has "poked" your printer's specifications into reserved memory space, it is no longer needed. Type NEW to erase it before you load the Level II BASIC program you intend using with your printer.

Documentation

In addition to containing instructions for connecting the interface unit to your printer and for using it, the ten-page booklet that comes with the TRS-232 contains several noteworthy extras. If you are curious about how the TRS-232 works, a section of the Instruction manual, entitled "Theory of Operation," will explain it to you in simple terms. In this section of the manual, the manufacturer points out that the TRS-232 is not certified as an interface that will meet all EIA Standard RS-232 requirements and specifications.

The schematic included with the manual shows how simple the design really is. The diagram promotes the idea—whether realistic or foolhardy—that anyone who can read a schematic should be able to troubleshoot and repair the interface unit. There should be no reason for anyone to return the Level II BASIC initialization program cassette to Small System Hardware because he can't load it into his computer.

Since the instruction manual contains a listing of the entire program (52 lines long—including 16 REMark lines that need not be used), it would be far simpler to type the program into memory using the computer's keyboard and then CSAVE it using your own computer, recorder and cassette tape. Because of slight record-head-alignment differences that exist among tape recorders, it is almost always easier to CLOAD tapes made on your own recorder than it is to load from tapes recorded on other machines.

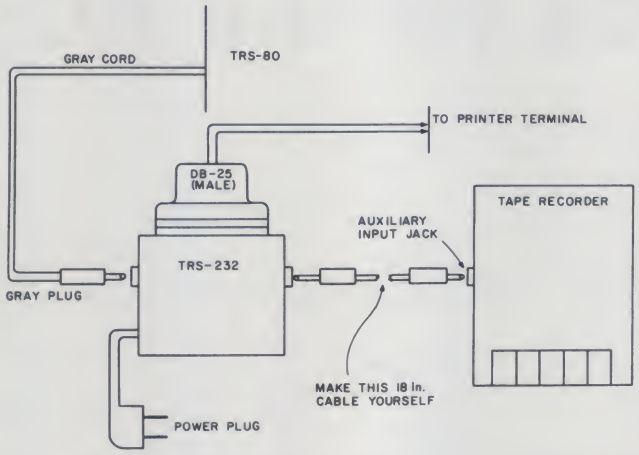


Fig. 1. TRS-80 connections that place the interface in series between the TRS-80 and the two output devices—printer and recorder.

Having the Level II BASIC listing in your instruction manual gives you peace of mind, too. Even if you do inadvertently store your initialization program cassette next to your TRS-80 system's power supply and partially erase it, you can always regain the use of your interface unit by typing and rerecording the program.

The instruction manual contains a special bonus for those who do their programming in Z-80 machine language. A complete listing in assembly language and machine code of the relocatable driver for the TRS-232 is provided. The code can be placed anywhere in memory since no calls and only relative jumps are used.

Baud rate selection (110 to 9600), line feed and nulls following carriage return options are provided, just as they are in the Level II BASIC program. Therefore, with the TRS-232 interface, you can obtain a print capability with your machine-language programs as well as with those that are written in Level II BASIC.

Conclusion

If you have a printer that you want to use with your TRS-80 system, you could hardly ask for a more reliable unit to tie computer and printer together than the TRS-232. Small System Hardware claims to have used the TRS-232 to interface with Diablo, Texas Instruments, Centronics, Teletype and Selectric printers.

Since the TRS-232 is not a kit—it comes fully assembled and tested—you will need no special skill, beyond the ability to follow written instructions, to install it in series with your TRS-80 microcomputer's output cable (the gray cord that terminates in a miniature plug enclosed in a gray plastic sleeve).

When you inspect the TRS-232 hardware housed in the 1 × 2 × 3 inch box, you may feel that the $49.95 price you paid for the unit is a bit steep. The price was $39.95 in December 1978 and jumped $10 at the beginning of 1979. However, when you remember that your purchase price also paid for a software package that will allow the same hardware unit to connect your TRS-80 to the next serial printer you acquire, the price doesn't seem too far out of line.

I am quite pleased with the hardware, software and instruction manual that comprise my TRS-232 interface. For my $50 interface investment, I obtained the use of a teleprinter that cost at least ten times that much. Particularly for a computer hobbyist, that's not a bad investment ratio. ■

Jerry Sorrels
6266 Banner Ct.
Riverside CA

Eyes for the AC-30

A simple modification lets you add monitoring features to your AC-30 cassette interface.

For over a year I had been using a Bit Boffer (see "Build a Bit Boffer," *Byte*, March 1976) to load programs into my SWTP 6800 computer. It worked just fine but lacked the ability to change from play to record and to start and stop the recorder under software control.

At first this was no problem . . . I had enough on my hands just getting the programs loaded and working. But as time went on, I became smarter and lazier.

Enter the SWTP AC-30 audio cassette interface. After using it for a short time, I missed one of the features of my old Bit Boffer: the ability to display the data on my SWTP CT-1024 terminal at the same time it was being loaded into the computer. This feature lets you verify if the tape is being read properly. Also, you know when the end is nearing.

But its best feature is that it gives you something to look at while waiting for the program to load. 300 baud is just a little slow!

After looking over the SWTP 19 × 25 inch schematic (nice and big), I came up with a simple way to add this monitoring feature to the AC-30. The only parts I used were an SPST toggle switch and a 1k resistor (see Fig. 1).

How It's Done

To add this modification to your AC-30, remove the circuit board from the case. Next, on top of the board, cut the trace between pins 10 and 11 of IC14 —it will be under the IC or its socket. I discovered that on the type of sockets I used (I always use sockets) the plastic housing could be pried off the pins and replaced after cutting the trace. What luck!

Now, on the bottom of the board connect a wire from IC14, pin 11 to an unused pin on the rear center board connector; next on the bottom, solder a 1k resistor, R1, from IC14, pin 11 to IC14, pin 16, which is +5 volts. Connect one side of the switch to the male pin that matches the vacant board connector you used. The other side of the switch connects to the pin that matches the rear center connector labeled LOCAL/$\overline{\text{REMOTE}}$ on the placement diagram.

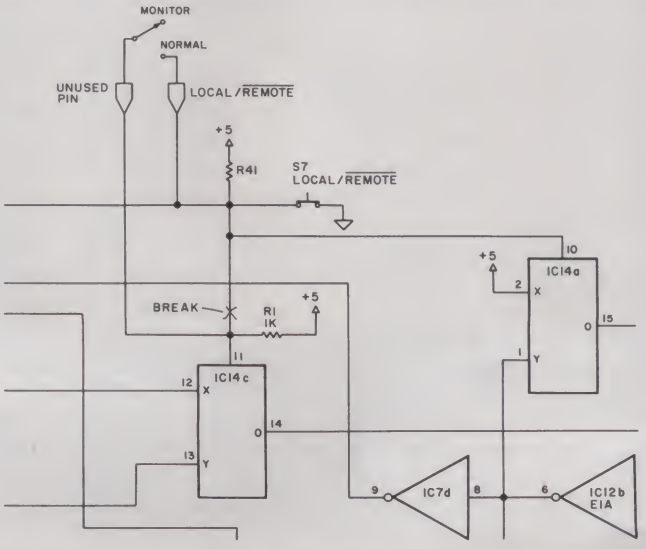


Fig. 1. Section of AC-30 cassette-tape-switching schematic showing modification.

I mounted the switch at the right rear of the cabinet, out of sight but still accessible. I have since considered moving the power switch to the back and the monitor switch to the front because sometimes I forget to put it in the normal position and wonder why the computer is not speaking to me.

When you want to monitor a tape you are loading, place the switch in its open position. This will change data selector IC14c from the computer to the cassette demodulator output. This causes the data to be sent to the computer and to the terminal. When the switch is in its normal position (closed), the AC-30 operates normally. This modification is especially useful when you're loading someone's tape other than your own for the first time without having to check its readability in the LOCAL mode first.

If the computer receives bad data during a normal load, it will send question marks to the terminal. Remember: With the switch in the monitor position, the terminal is looking at the AC-30, not the computer; but if there is bad data, the TVT should show it anyway. ■



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✓ Reader Service—see page 227

Expanded TRS-80 Disk Operations

Putting "system" programs on disk is the topic in this, the first of a two-part series.

Allan J. Domuret
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This article has two objectives. One is to explain how to put low-RAM machine-language programs on disk, a procedure that is not routinely supported by the Radio Shack disk operating system (DOS). Second, the techniques described herein will serve as a good introduction to machine-language programming for beginners.

The techniques make use of the Small System Software RSM2 or RSM2D machine-language utility program. RSM2 has many features, and only a few are described hereln. If the user does not have RSM2 in his software library, this article can still be educational. It is suggested, however, that RSM2 or RSM2D is an invaluable utility for TRS-80 owners. RSM2D is the disk version of RSM2.

TRS-80 Disk Operations

The comparatively low price of the TRS-80 microcomputer, no doubt, contributes considerably to its popularity, but, as an old philosopher once said, "You get what you pay for." It seems that whenever a TRS-80 user updates or adds to his system, he encounters some kind of new frustration. What I refer to is a deficiency in Radio Shack's DOS, which precludes loading system programs such as the Electric Pencil, EDTASM or T-BUG from disk because these programs reside in the same memory area as does DOS.

To quote from the new Radio Shack "Disk Operating System" manual for TRSDOS Version 2.0: "Most Radio Shack system tapes designed for use with Level II TRS-80s will not work under Disk BASIC because of differences in RAM usage under Disk BASIC and Level II" (pp. 5-6). On the same page of the DOS manual is a comment that states, "Do not attempt to use Tapedisk to load tape files that load below hexadecimal address 54F4 (decimal 21748). Tapedisk uses this area." (Tapedisk is a utility program that allows the user to place system tapes on disk, provided that memory required by the system program does not overlap that required by Tapedisk or DOS.) In other words, it is not possible (normally) to put a machine-language program on disk if the program conflicts with DOS in low RAM.

This means that the inexperienced TRS-80 user cannot easily put system programs such as T-BUG, Electric Pencil or Editor/Assembler on disk with available routines such as Tapedisk. With a little skill and cunning, however, it is possible to load these low-RAM system programs from disk, thereby eliminating the need for much slower tape loading.

The technique involves loading the desired system program into upper, unused memory with RSM2. Then a short block-move subroutine (15 bytes) is permanently attached to the system program to automatically move the entire system program to its proper memory location for execution. Finally, the Tapedisk routine is used to put the program and its block-move subroutine onto disk.

Subsequently, when the program is loaded from disk, it is loaded into upper memory with an execution address that initiates the block move. The block move takes over and transfers the program to its proper memory location. When the block move is completed, a jump to the program's execution address completes the operation. The program will then run normally.

Moving the system program to lower RAM in this way overwrites DOS because DOS resides in the same memory location as the moved system program. But this is inconsequential because only the system program will be run—DOS will not be needed while the system program is running. For example, DOS and the Electric Pencil normally reside in the same memory area, but only one program will be used at a time. Wiping out DOS by overwriting it with the Electric Pencil does nothing to interfere with normal Pencil operations.

The "Save-to-Disk" technique described in this article will use the Electric Pencil as an example, but the reader, if he understands what is happening in this simple routine, can apply the same technique to other system programs such as T-BUG, Radio Shack's Editor/Assembler, and so on.

The recent release of a disk version of the Electric Pencil for the TRS-80 will not obviate the relevance of the procedures described in this article. The technique is still applicable to any system program, and, no doubt, there are those who may not be able to afford the new disk version of the Pencil.

Also, the ability to load the Editor/Assembler from disk eliminates much of the drudgery from machine-language programming. It only takes a moment for your machine-language program to crash, but it takes many frustrating minutes to reload the EDTASM and the source module for making repairs.

Part 2 of this article will explain how to put Peter Jenning's Microchess 1.5 on disk and also how to make backup copies on cassette tape. As most TRS-80 users have become aware, Microchess 1.5 cannot be duplicated on cassette tape by ordinary means. You paid good money, however, to purchase Microchess, and we all know the importance of having backups of valuable programs. It is also an educational experience to learn how to duplicate Microchess. I can only encourage TRS-80 users not to abuse this knowledge by making free copies for friends.

(Sorry, Mr. Jennings, but knowledge must be shared.)

RSM2 and RSM2D System Monitor

As I stated, RSM2 and RSM2D will be used as a tool to accomplish our purpose. The only difference between RSM2 and RSM2D is that the latter has some disk-related features. These disk features are not required for the techniques employed in this article, so they will not be referred to again. Subsequent references to RSM2 apply as well to RSM2D.

RSM2 has several tape-related features that enable the user to read and write system tapes and to read virtually any machine-language tape into memory (including Microchess). These tape features are necessary for structuring system programs that will eventually be saved on disk.

Before proceeding, I should mention that either the 32K or 48K version of RSM2 is preferable to working with the 16K version. If you must work with the 16K version because of limited memory availability, it will be necessary for you to determine your own memory-address requirements as described in this article.

Using the 32K or 48K version of RSM2 should present no problems because most TRS-80 users quickly learn that a 16K system with DOS is really not enough. Consequently, they usually move up to 32K or 48K of memory rather quickly. Those of you who will be using the 32K or 48K RSM2 can use the program address numbers exactly as provided in the following paragraphs.

The first step in creating our disk file is to determine the start, end and execution addresses of the selected system program. As was stated above, we will use the Electric Pencil for our example. To determine these addresses, load either the 32K or 48K version of RSM2 as you would any typical system program.

If you are still limited to a 16K TRS-80, it will be necessary to work in BASIC II rather than in Disk BASIC. The reason is that Disk BASIC occupies memory space that, when added to memory space used by RSM2, leaves an insufficient amount of memory for our operations on the Pencil program. In spite of limitations imposed by 16K systems, the techniques described herein will still work for loading Pencil from disk.

After RSM2 is operational, it would be a good idea to clean up all memory locations to avoid confusion later when working on the Pencil. Before loading Pencil into memory, zero out all memory locations from 4200 hex to a place in memory just short of running into RSM2. For a 16K TRS-80, RSM2 resides at 6C00 to 7EFF hex (see "Supplementary Information" provided with RSM2 documentation). The command for a 16K system would be: "Z 4200 6BFF." For the other RSM2 versions, zeroing memory from 4200 to, say, 8000 will be adequate for our purposes.

Now when we load in the Pencil program, there will be nothing else in lower RAM to confuse us as to which instructions belong to Pencil and what might otherwise be hanging around as leftovers from DOS or some other program that is no longer needed. The only memory locations that will not be zeroed will be the Pencil program, which we will load.

Prepare the cassette recorder and read in Pencil with the RSM2 "R 0" command. When the Pencil is loaded, RSM2 will display the file name—PENCIL—and it will also display the execution address. For Pencil, the execution address will be 4350 hex. Write down the execution address for later use.

By the way, in case you wondered, the Pencil execution address is physically located at the end of the cassette tape program, and this holds true for most system programs. This is how the TRS-80 knows where to go to execute a system program when you enter the slash (/) after normal tape loading, and this is how RSM2 is able to tell you what the execution address is.

If you want to check this out, read the Pencil into memory with the RSM2 "R" command (in contrast to the R 0 command). The R command will load in the program and will display the execution address at the end of the program. The R command is used for reading in non-system programs, but will read in system programs with all coding characters preserved in memory. The execution address for a system program will follow the termination code "78" at the end of the tape.

After loading Pencil with the RSM2 R 0 (not R) command, Pencil should be in its normal memory location, but RSM2 will still be in command of the machine. To determine Pencil's start and end addresses, use either the RSM2 ASCII or symbolic dump commands. The ASCII dump is faster for locating the Pencil in memory, but the symbolic dump is more precise in determining exact start and end addresses.

To get an ASCII dump, answer RSM2's "COMMAND?" prompt with: "A 4300." This will give a scrolling ASCII display of everything in memory starting from memory location 4300 hex. Stop the scroll as desired with the space bar. Since we initially zeroed all memory locations before starting, and since RSM2 resides in higher memory, we can be certain that the first nonzero data encountered during the ASCII or symbolic dump belongs to the Pencil that we loaded in with RSM2.

Since the ASCII dump makes it difficult to precisely read program addresses, the exact start address for the Pencil can be determined with the RSM2 symbolic dump. Start the symbolic dump at, say, 4300 hex by typing in: "S 4300." Notice that adjacent to the displayed memory locations between 4300 and 434F are zeros (00) and NOPs. This is because we zeroed all memory before loading in the Pencil. When the dump reaches 4350 hex, the start address for the Pencil, you will see:

```
4350: C3 DA 52        JP        52DA
```

followed by the rest of the program in Zilog mnemonics.

The first column (4350) is the hex memory location of the first instruction in the program; the second column group (C3 DA 52) represents the hex op codes, which tell the computer what to do; and the next column group (JP 52DA) represents the symbolic code to JUMP to memory location 52DA hex.

To find the end address, just let the memory scroll continue until a long string of zeros is again encountered. By now, the importance of zeroing all unused memory as we did at the start should be obvious. The last instruction in the Pencil program should read:

```
5365: 29        ADD        HL,HL
```

The end address is 5365, and the 29, rather than representing a machine-language op code, is actually an ASCII character for ")". An "ADD HL,HL" symbolic instruction is displayed because the RSM2 disassembler interprets the 29 op code as an "ADD HL,HL" instruction. RSM2 really has no way of telling if the 29 is an ASCII character or an op code without actually running the Pencil program.

This is a common fault for most disassemblers, and the user should always be aware of this problem so that ASCII characters are not inadvertently interpreted as op codes. ASCII characters can be found easily with RSM2 by dumping memory with the ASCII dump command and finding the English language text in the program. For Pencil, this English language text is found in upper memory.

At this point, I must add that Pencil is recorded on the cassette tape with ten trailing zeros after the last code, 29. I learned this by loading Pencil into memory with the RSM2 R command, in contrast to the R 0 command. The R command will read virtually any tape, whereas the R 0 command is for reading only system tapes.

If you care to experiment, read in Pencil using the RSM2 R command, and at the end of the program you will find the ten trailing zeros, followed by a few other characters, including the '78' termination code and, at the end, the execution address as I mentioned above. Little peculiarities like these must be found when manipulating programs at the machine-language level. At

this point, we will keep in mind these ten trailing zeros and account for them later.

After copying down the start and end addresses, you should have available all the information you need to continue: the start address, the end address, the execution address and the file name, PENCIL.

Figuring Program Length

Since we now have the necessary start, end and execute memory address information for Pencil, we must compute the program length. This is needed in order to determine how much memory is eventually to be block-moved and how much memory is to be transferred to disk. Simply subtract 4350 hex (the start address) from 5365 hex (the end address).

It is not my intention to give instructions here on how to do arithmetic in hex . . . there is plenty of source material available for that. Very briefly, however, it is not much different than doing adds and subtracts in the decimal system, the only difference being that when borrows or carries are done, we borrow or carry 16 for a hex problem rather than 10 as in a decimal problem. In our subtraction problem for the Pencil, there is no borrow needed.

```
 5365
 4350
------
 1015
```

Observe that this works out just as if it were an ordinary decimal subtraction problem because no carries are involved. As another example, suppose that we needed to subtract 4359 hex from 5365 hex.

```
5365  )              5 3 5 21
      )
4359  ) Becomes      4 3 5  9
      )              -------
      )
100C  )              1 0 0 12
                     (or 100C hex)
```

Nine cannot be subtracted from 5, so we borrow a one from the 6 in the numerator. This borrowed 1 from the second digit is actually a 16 in the least significant digit. It is necessary to add this borrowed 16 to the least significant digit (5) for a total of 21. Now subtract 9 from 21 and get 12. Twelve is represented in hex by a C; hence the C is the least significant digit in our answer. The rest of the subtraction is completed without any additional requirement for borrowing.

Of course, you can always take the easy way out and let RSM2 do the hex arithmetic for you. Simply type in the two hex numbers with the appropriate command, and RSM2 will give the sum and difference for the two hex numbers in both hex and decimal notation (see page 4 of the RSM2 documentation). The command for this binary arithmetic is:

```
B 5365 4350
```

RSM2 will return with both the hex sum and difference for these two numbers: 96B5 and 1015 hex, respectively.

Getting back to our Pencil problem, we subtracted 4350 hex from 5365 hex for a difference of 1015, but determining the true program length requires that we add 1 to 1015 for a program length of 1016. The reason for this can best be explained with an example.

Suppose we had a trivial machine-language program residing in memory locations 1 through 5 inclusive. But subtracting 1 from 5 only gives us 4, whereas we know that the program actually occupies five memory locations. It is necessary, therefore, to always add 1 to the arithmetical difference between the start and end addresses when we want to determine the exact program length. We conclude that our Pencil program is 1016 hex bytes long. (For informational purposes only, that figures out to be 4118 bytes in decimal.) Write down the hex program length for later use. (No, I haven't forgotten the ten trailing zeros. I will get to them eventually.)

Relocating Programs in Memory with Block Moves

We now know that Pencil starts at memory location 4350 hex and up, and we should also hazard the guess that DOS and most TRS-80 disk routines overlap this same low-RAM memory area. To reiterate, the trick we hope to accomplish is to have DOS load Pencil from disk into a higher area of unused memory where the two don't overlap; then when Pencil is safely in an unused area of memory, we want it to automatically move itself to a start address of 4350 hex after DOS is no longer needed. Actually, this is simple to do.

Eventually, we are going to use the Tapedisk utility to put Pencil on disk. But first, recall the warning from the TRSDOS manual: "Do not attempt to use Tapedisk to load tape files which load below hexadecimal address 54F4. . . ." If we can get Pencil to initially load from disk to a higher memory location than 54F4, we should be in good shape.

Memory	Op Code	Mnemonic		Comments
7520:	F3	DI		;Disable Interrupt
7521:	21 00 65	LD	HL,6500	;Source Address
7524:	11 50 43	LD	DE,4350	;Destination Adrs
7527:	01 20 10	LD	BC,1020	;Byte Count
752A:	ED B0	LDIR		;Block Move Inst
752C:	C3 50 43	JP	4350	;JP To Execute Adrs
752F:	FF			

Table 1. Block-move instructions.

Actually, I have found through trial and error that it is better still to load the Pencil program from disk into memory above 6000 hex. If the Pencil is set up to load at, say, 5500 hex, DOS sometimes does funny things because this area of memory is the DOS "overlay area." Play around with this by utilizing memory starting at 5500 hex, rather than 6500 hex, as will be described below, and see what happens.

My TRS-80 will run the program but will not load it. You can't hurt anything if your disk is write-protected and if you keep a backup copy of the program you are working with. For our purposes, it works fine if memory locations 6500 hex and up are used for the Pencil. Take my word that this will eliminate some unexpected problems. Those of you confined to a 16K memory will have to use 5500 rather than 6500 for your working memory address as described below.

If DOS can load Pencil to memory location 6500 hex, DOS will have done its job and will no longer be needed, and Pencil can subsequently be moved to its proper location at 4350 hex. So let's move Pencil from where it was initially loaded at 4350 hex to memory location 6500 hex, using RSM2. The RSM2 command which will accomplish this move is:

```
M 4350 5365 6500
```

This command says: "Move data (i.e., the program) residing between memory locations 4350 and 5365 hex inclusive and move the whole thing to a destination address starting at 6500."

After you have performed this operation, use the RSM2 ASCII or symbolic dump to verify that Pencil has indeed been relocated. With the symbolic dump command, you will find Pencil's first instruction—JP 52DA—residing at memory location 6500 hex, exactly where you moved it to. You can also verify that the original Pencil, which was initially loaded at 4350, is still there, but you can ignore it now because we will no longer need it.

The next step is to put the 15-byte block-move routine on the tail end of the relocated Pencil, which is currently residing at memory location 6500 hex and up, so that Pencil will automatically load itself into its proper memory location at 4350 hex after DOS is no longer needed. Refer to the block-move instructions in Table 1.

There are several important points to note in Table 1. First, the block-move instruction is put into unused memory starting at 7520 hex. This unused memory is at the tail end of Pencil and allows for the ten trailing zeros that were mentioned earlier. The relocated Pencil should be residing at 6500 to 7515 hex inclusive; and the last

memory location at 7515 should read "7515: 29 ADD HL,HL," just as it did in the originally loaded Pencil, except for the 7515 address. Then we skip down to memory location 7520 for inserting the block-move instructions. This allows for the trailing zeros.

Second, when we are finished, this block-move routine and the trailing zeros will become permanently attached to the tail end of the Pencil program. After explaining what the block move does, we will go ahead and program it in with RSM2.

The first instruction—DI—means "disable interrupts." Its purpose is simple, but important: We don't want any interrupts interfering with the block move while it is being accomplished by the Z-80 CPU. What we are actually doing is turning off the real-time clock in the computer so that it will not tick in the midst of the block move and mess things up. (This is what you do when you type "CMD T" before loading or saving a cassette tape. You are turning off the real-time clock so that it does not interrupt tape operations.) The machine-language op code that disables interrupts is F3.

The next instruction—LD BC,1020—is the byte count loaded into the BC register. Remember, we computed this byte count earlier, but this time we are accounting for the trailing zeros. We will be moving 1020 hex bytes. The op codes for "load BC with something" is 01, and BC is loaded with 1020 hex.

Note: In the op-code column the 1020 hex byte count appears to be reversed when reading from left to right. Rather than reading "01 10 20," it says "01 20 10"—the 20 and 10 are reversed! This is normal and occurs because the CPU works sequentially; after it gets the "LD BC" instruction (01), it next looks for the least significant byte, which, in our case, is the 20. Next, the CPU looks for the most significant byte, which is 10.

Be aware of this convention to avoid future problems in machine-language programming! The Zilog mnemonic reads according to English language convention because it says LD BC,1020, which is how it would be actually programmed if you were programming in assembly language with the Editor/Assembler. But the machine-language instruction appears to be reversed. We will be programming in machine language, not assembly language, with RSM2.

The next instruction says to load 4350 into the DE register. This is the destination address for the block move that we will be programming in; it is where Pencil has to be moved to after DOS initially loads it to memory location 6500 hex. The machine-language op code is "11 50 43." Note again that the 4350 destination address in the op code reads backwards as 50 43.

The next instruction is the source address (6500) where the first Pencil instruction is residing. It is where the block move will be initiated when it starts to relocate Pencil from 6500+ to 4350+ hex. The source address is loaded into the HL register, and the machine-language op code is "21 00 65." The 6500 address is again reversed to 00 65 in the op code.

The LDIR instruction is the biggie; it accomplishes the entire move using the information stored in the BC, DE and HL registers. Here is how it works:

1. Get the first byte contained in the memory location referenced by the HL register—6500, in our case. This is the source address.

2. Move this byte (i.e., C3 op code) to the destination address referenced in the DE register—4350, in our case.

3. Decrement the byte count in the BC register. Increment the HL register and get the next byte. Increment the DE register and load this next byte to the new address referenced by DE.

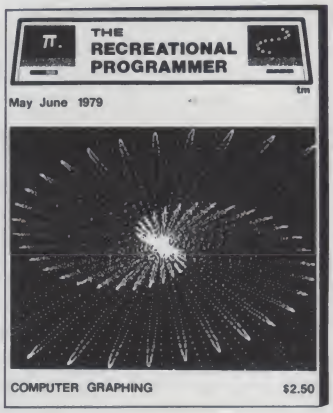
4. Repeat step 3 until the BC register reads zero. Thus, the whole program will be moved.

Note that the block-move routine forms a loop. The CPU will continue within the block-move loop until the byte count in the BC register is zeroed. After the move has been completed, there is one more instruction: "JP 4350." This jump is to the execu-

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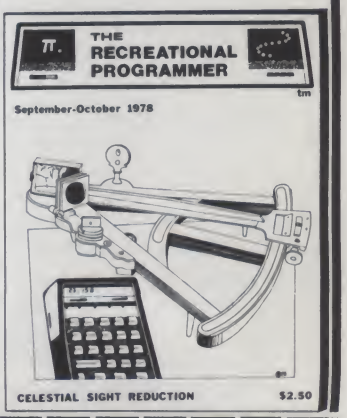
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tion address for Pencil. After this jump, Pencil will start.

Before proceeding with instructions on how to get the Pencil and its block-move program onto disk, it might be worth repeating that this technique can be used with almost any machine-language program. It will be necessary to put the proper data into the BC, DE and HL registers, and the JP to the execution address will have to be determined. Consequently, the user will have to perform the same operations that we have so far accomplished with RSM2 for Pencil; that is, determine the start, end and execution addresses for the program being processed. Then relocate the program to unused memory (6500 will usually be a good choice for the TRS-80) and attach a block-move routine. The only differences involved in the block-move routine will be the byte count, destination address and source address loaded into the BC, DE and HL registers, respectively, and the execution address for the final jump.

Programming the Block Move with RSM2

Programming the block move with RSM2 is quite simple. The command is E (for edit), followed by the address to be edited and the appropriate machine-language op code. Only the initial address where RSM programming is to begin needs to be typed in. After the appropriate machine-language op code for that memory location is typed in, RSM2 will automatically increment to the next address, and only subsequent op codes need be entered. Here is what it will look like on the TRS-80 display after typing the command "E 7520":

```
7520 00-F3, 00-21, 00-00, 00-65, 00-11, etc.
```

The first command (E 7520) simply says edit memory starting at address 7520 hex. RSM2 then will display this address, followed by the current memory contents, which should be 00 because we initially zeroed all memory before starting this operation (it is becoming increasingly apparent that this initial zeroing of memory was a pretty smart move, right?). The user now types in F3, which is the op code for DI, or Disable Interrupt. RSM2 then digests this op code and displays the contents (00) of the next address at 7521 hex.

After F3 is entered, continue by entering: 21, 00, 65, 11, 50, 43, 01, 20, 10, ED, B0, C3, 50 and 43, in that order. Note that these op codes are obtained from the op-code column shown in Table 1. After all the op codes have been entered, hit the Break key to finish programming.

For those of you who are relatively new to machine-language programming, it might be worth mentioning that these machine-language op codes can be found in most references oriented to Z-80 programming. The Radio Shack Editor/Assembler and William Barden Jr.'s *The Z-80 Microcomputer Handbook* are two examples.

To double-check the programming of our block move, get a symbolic display with RSM2 by typing "S 7520." The symbolic display should be identical to that shown in Table 1, except for the comments. If you made any errors, go back and re-edit the memory where the error was made. When the block-move mnemonics appear exactly as shown in Table 1, we are ready to put Pencil and its accompanying block-move routine onto disk.

Before putting our dormant Pencil program on disk, it would be a good idea to make a cassette tape backup copy of the program. In addition to the security provided by a backup copy, the cassette recording procedure will demonstrate another one of RSM2's useful utilities, which is to make system tapes, either originals or duplicates. In our case, we will be creating an original.

To put our "modified" Pencil on tape, give the following command to RSM2:

```
P 6500 7530 7520
```

This command says punch (record) a system tape, recording the data in memory starting with a 6500 hex start address, a 7530 hex end address and a 7520 execution address. RSM2 will then ask you to assign a file name. Be sure to prepare the cassette deck for recording before entering the file name.

After Pencil is safely on tape, you might want to try a little experiment to make sure the dormant Pencil program is capable of moving and executing itself. To activate the block move, give the following command to RSM2:

```
G 7520
```

This command says to go to memory location 7520 and execute the program located there. Upon entering this command, Pencil will become operational almost instantly, assuming you made no mistakes. It is impressive how quickly the block-move routine relocates the 4028 (decimal) byte Pencil program.

It is perhaps important to mention that when Pencil is activated with the "G 7520" command, it (Pencil) claims all available memory by clearing it. Consequently, the dormant Pencil that was residing at memory location 6500 hex will be wiped out, and so will RSM2. But since we have Pencil on tape, all that is necessary is to reload it before putting it on disk. This can be accomplished either by the usual system tape loading procedure or, in our case, with the Tapedisk utility.

To reemphasize, putting Pencil on tape as we just did is optional. We could have put Pencil directly onto disk with Tapedisk without this interim step. I have found, however, that many individuals like to have a cassette backup of disk programs . . . just in case.

Putting the Program on Disk with Tapedisk

If you did not activate Pencil as described in the immediately preceding step, it will not be necessary to reload Pencil from the tape we created. In either case, the procedure for loading the tape using Tapedisk is as follows.

After bringing up DOS and calling up Tapedisk, a question mark prompt will be displayed. Prepare the modifled Pencil tape in the cassette recorder, type C and enter. Tapedisk will load Pencil and retain control of the computer.

After loading, another question mark prompt will be displayed. At this point, you should be sure to have a disk ready to receive the new Pencil program. The following command will save Pencil to disk.

```
F PENCIL/CMD:0 6500 7530 7520
```

The F is the required Tapedisk command for copying to disk (I don't know what F stands for—maybe "From" memory to disk). PENCIL/CMD:0 is the file name to be written to drive 0, and the user is, of course, free at this point to make appropriate changes, loading to a different drive number or modifying the file name. The rest of the command is the now familiar address information in the usual order: start, end and execution addresses. These addresses must be exact.

Upon entering the command, Pencil will be transferred from memory to disk. That's it—we are finished! Give it a try by calling up Pencil with DOS. Pencil should work almost instantly if you did everything correctly.

Although the step-by-step procedure as described herein seems lengthy, it is really not all that complicated. The length of the instructions provided in this article was intended to make things as clear as possible for the TRS-80 user who is relatively new to machine-language programming. After practicing this operation a couple of times, it should not take more than a few minutes to put any system program on disk.

To show that the procedure can work with just about any machine-language program, part 2 will demonstrate essentially the same procedure for the "uncopyable," although slightly more complicated, Microchess 1.5. ■

Author's note: When I initially wrote this article, the Radio Shack DOS 2.1 (disk operating system software) was the only DOS we TRS-80 users had available. In recent months, however, two disk operating systems have been released: Radio Shack DOS 2.2 and NEWDOS by Apparat. (Editors' note: see next month's issue for a review of NEWDOS.) A third is on the way: DOS 3.0, which is an improved version of the original

DOS 2.1. The latter two systems were both written by a gent named Randy Cook.

The release of the first two disk operating systems (NEWDOS and DOS 2.2) affect the computer memory block-move techniques discussed in my two-part article; the potential problem derives from the fact that both of the new DOS systems insert a keyboard debounce routine in the midst of DOS RAM memory. The procedures described in the article main text will not function properly without some additional software changes. These changes—and they are brief—are provided in the following paragraphs.

As of the time of this writing, I have not yet had access to Cook's DOS 3.0, so the ensuing comments apply only to NEWDOS and DOS 2.2.

The Nature of the Problem

NEWDOS inserts its debounce routine starting at memory location 4378 hex, and DOS 2.2 initiates its debounce routine at memory location 43D8 hex. The problem occurs when certain machine-language files are loaded to high RAM from disk and subsequently relocated from high RAM to low RAM, thus overwriting the resident DOS. (If this is not clear to the reader, read and understand the main text of the article, then come back to this errata).

When the resident DOS is overwritten in this way, the keyboard debounce routine, as employed by both NEWDOS and DOS 2.2, is also overwritten. Since the DOS keyboard debounce routine makes up part of the keyboard scan routine (the keyboard scan routine continuously "looks" for keyboard inputs), the effect is that when the debounce routine is overwritten, the keyboard scan routine also gets messed up and the whole system crashes.

The NEWDOS Solution

For NEWDOS, the solution is simple. The authors of NEWDOS thoughtfully provided a means to defeat the keyboard debounce routine: Simply hold down, simultaneously, the SHIFT and UP-ARROW keys while either powering up or reseting the the TRS-80. With the keyboard debounce defeated in this way, the disk loading and subsequent relocation of machine-language files from high to low RAM—as described in the main text—will not cause any crashes or problems. Your keyboard debounce will be lost, but at least you can still load and run your low-RAM machine-language programs from disk.

The DOS 2.2 Solution

The solution for DOS 2.2 is not quite so simple; the DOS 2.2 authors did not provide a way to easily defeat the keyboard debounce routine. Consequently, more drastic methods are required to defeat the keyboard debounce to overcome the problem.

To defeat the DOS 2.2 keyboard debounce, it is necessary to restore the keyboard driver address in the device control block (DCB) to its "original" configuration (i.e., as it was originally used by DOS 2.1). This is not as scary as it sounds. All that is required is to change the driver address from its DOS 2.2 configuration, 43D8 hex, to its "old" configuration, 03E3 hex. How do we accomplish this? Simple. Here is the machine-language code for this short routine:

OP CODE	MNEMONIC
21 E3 03	LD HL,03E3H
22 16 40	LD (4016H),HL

This short and simple code will defeat the DOS 2.2 keyboad debounce if properly inserted in your machine-language program. Where should that be? I recommend that you put it at the start of the block-move code that is developed in the main text. Example 1, is a duplication of the Electric Pencil block-move routine with the keyboard debounce defeat routine inserted. Notice that the memory address references have been adjusted to accommodate the extra six bytes of instructions.

With this extra six-byte patch, the DOS 2.2 keyboard

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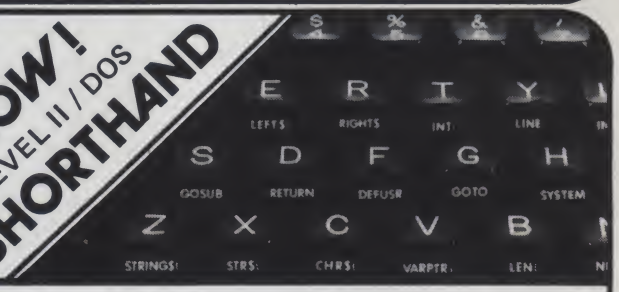
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Memory	Op Code	Mnemonic	;Comments
7520:	21 E3 03	LD HL,03E3H	;REQUIRED DCB ADRS
7523:	22 16 40	LD (4016H),HL	;LD TO DCB
7526:	F3	DI	;DISABLE INTERRUPT
7527:	21 00 65	LD HL,6500	;SOURCE ADDRESS
752A:	11 50 43	LD DE,4350	;DESTINATION ADRS
752D:	01 20 10	LD BC,1020	;BYTE COUNT
7530:	ED B0	LDIR	;BLOCK MOVE INST
7532:	C3 50 43	JP 4350	;JP TO EXECUTE ADRS

Example 1.

debounce will be defeated, but your relocated low-RAM program will load and run normally. Also note that your execution address will be at memory location 7520.

It is, perhaps, useful to note that the Electric Pencil does not require this debounce defeat because the Pencil employs its own keyboard scan routine. The Pencil was used here only as an example. In part 2 of this block-move article, which addresses the application of the block-move techniques to Microchess 1.5, it will be necessary for the reader to insert the six-byte debounce defeat, as described herein, in a similar manner. This operation will be left as an exercise for the reader.

Other low-RAM machine language programs, such as T-BUG, Microchess, AIRAID and so on, will require the debounce defeat instructions if you are using DOS 2.2. But if you are using NEWDOS, the solution is much simpler. Merely defeat the NEWDOS keyboard debounce as described above; it is not necessary to incorporate the six-byte code as is required for DOS 2.2.

By the way, for you NEWDOS users who wondered about the "Appendage" and the "Disable Interrupts?" prompts used by the LMOFFSET module, the answer as to what these are should be obvious after you read my article. The Appendage is the block move routine (LD BC, LD DE, LD HL and LDIR), and the Disable Interrupts? query simply refers to the DI (OP CODE F3) instruction. You should always Disable Interrupts when doing a block move of any kind with the TRS-80.

That's about it, folks. By the time this is published by *Microcomputing*, Cook's DOS 3.0 should be on the streets. With this additional DOS you are on your own.

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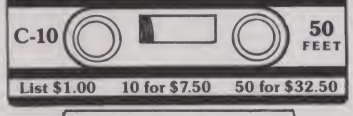
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Anatomy of a Scam

Remember World Power Systems? Here's the story on how that world crumbled.

Terry Kepner
Instant Software Staff

Colonel Winthrop" is a name that strikes terror into the heart of any microcomputer businessman or hobbyist who depends on mail-order business.

Colonel Winthrop; alias David Winthrop; alias Harry Hunt; alias Jim Anderson (alias ?) has done it again. This time it was called World Power Systems, Inc. World Power Systems (WPS) was not incorporated, neither did it have a business license.

What it did have was an office at 1161 N. El Dorado Circle, Tucson, Arizona; three self-storage lockers of computer components and related equipment; office supplies; many bewildered employees; four (or more) bank accounts; a few hundred thousand dollars of debt; and hundreds of upset and dissatisfied customers and suppliers. All this in only four months!

How did it happen? How did it start and how did it stop? How does someone get the money and hundreds of thousands of dollars of credit in only a few months—especially someone who is wanted on a federal warrant as an escaped convict?

Of course, Colonel Winthrop does have a few advantages: He's an electronics technician who knows more than enough to design and build a microcomputer, and he is a very persuasive talker who can throw enough bull to get out of almost any jam.

Actually, if he was willing, he could probably set up a legitimate computer business and make a good profit for himself.

The Beginning

It began in January 1979, when Perry Pollock, an Arizona resident, signed contracts with Jim and Lee Anderson establishing a company to be named World Power Systems, Incorporated. These contracts established Perry as R & D manager, Lee as vice-president and Jim as president of the corporation. Mr. Pollock would help supply the venture capital and credit, while Jim and Lee supplied the technical expertise.

Phase I

With these contracts, they applied for a business loan using Perry's established credit history as a major reference. The money they received went toward office rent, storage locker rent, some R & D work and advertising layouts.

They then applied to Leasametrics of San Diego, California, for leasing credit to acquire office equipment and furnishings. Leasametrics performed a credit check on the reference supplied, Mr. George Pollock, and contacted the bank that had lent them the money. Satisfied with this check, Leasametrics OK'd the credit and sent the items WPS had requested.

For a while things were quiet as WPS laid the groundwork for the next step. An advertising campaign was planned and ad sheets prepared. Several magazines were approached about advertising rates and printing deadlines. When the ad sheets were ready, they were sent to the magazines, along with the payments for advertisements. Locally, in Tucson, WPS began making purchases of equipment from the Byte Shop and Radio Shack, also by paying in full. They also made a few out-of-state purchases, always including the payment with the order.

When the magazines came out, orders started to come in to WPS. At first the orders were filled and shipped promptly, but as the orders increased WPS began to fall behind in their shipping. Customers were sent stalling letters. These letters blamed WPS suppliers with failure to supply needed merchandise as rapidly as had been promised and cited this as the reason for the delays in shipping the customers' orders. WPS did promise to ship the merchandise as quickly as possible and asked the customers to please be patient.

Phase II

Then the funny stuff started. Using Leasametrics as its major reference, plus its reputation at the local Byte Shop and Radio Shack, WPS began to ask their equipment suppliers for credit on their orders. Because of WPS's previous practice of prompt payment and their good credit check, the vendors usually agreed to this simple credit request.

Things moved into high gear. WPS placed orders for large quantities of equipment: disk drives, RAM chips, circuit boards and practically anything else dealing with computers. These orders were usually placed by the use of a purchase order, with instructions on where and how to receive payment for the items on the order. These instructions included the statement that payment would be made in about 30 days.

As their reputation, a good one so far, spread, more people ordered merchandise from WPS. By the time their second advertisement was released they were doing a booming business, and they hired more help, including two office secretaries to handle all the incoming phone and mail orders.

With the announcement of the availability of a Radio Shack-compatible disk drive and a replacement unit for the RS Interface, the number of orders increased to a veritable flood. There were dozens of phone orders and scores of mail orders streaming in daily.

Almost all the orders included payment, and, as a re-

sult, the WPS bank accounts grew rapidly. However, the shipping department was hopelessly behind by then. For every ten orders that came in, only one was filled and shipped; the backlog of orders would take months of hard work to fill and ship. And that would be if WPS ceased taking any more orders and concentrated only on the shipping department. The employees knew this and wondered why the production facilities were so slow. They were given the line about the vendors being late in their shipping, which slowed down WPS production. Because of this and because WPS was still shipping things out, the employees were not suspicious about the real intentions of the head people.

Phase III

WPS initial credit orders from their vendors began to be due. This was usually indicated by a letter from the vendor inquiring as to why he had not been paid, and politely requesting payment. These suppliers were sent stalling letters, usually saying that the statement from the vendor had been mislaid and the letter had arrived too late for the current billing cycle, but that the payment would be sent within the next two weeks.

Some vendors called instead of writing; they were told the same story. These tactics usually sufficed in delaying the next letter or call for at least three weeks, sometimes for as long as two months.

At this point, before WPS credit was canceled because of nonpayment, more merchandise was ordered from the suppliers. These new shipments further lulled the suspicions of the employees by making it possible for them to fill and ship some more orders, which in turn satisfied some of the customers and gave credence to the claim that WPS was attempting to fulfill its obligations. In Tucson, they were filling orders quickly to prevent any immediate problems with the local authorities. For the same reason, they were also keeping the rent payments and employee wages on a business-like and timely basis.

Under normal circumstances, this phase of the scam would last for about two months. Orders would come in by the hundreds, and only enough would be filled and shipped to prevent the complaining customers from going to the proper authorities. Naturally, those that complained the loudest would have their orders filled first. Also, the creditors would be put off even more, usually by claiming that the vendor's statement was in the billing process and would soon be mailed. When this did not work, the trick was to say that the payment was in the mail and to request notification if it wasn't received within the following two weeks.

And the orders would still come in.

Phase IV

Eventually, everything would come to a head. The creditors would threaten to go to the police and courts for their money; the customers would threaten to go to the Better Business Bureau and to the police to get their equipment. At this point Phase IV would be initiated. This would entail cleaning out the bank accounts, shifting the merchandise around from one location to another and leaving a confusing trail as to its exact location—and setting up a fall guy.

The fall guy would be a promising and unsuspecting employee whom they had been carefully leading on. He or she would be told that because of his/her extremely good business sense and/or aptitude that the company was going to promote him/her to president of the company.

This person is usually the sales manager or an assistant to the current president or vice-president. The "president-elect" is given a short training period and then given a raise. After only a few days, he/she is told the other officers are taking a much-needed vacation for a week or so and that they will see him/her later. Before they give the new president the keys, they clean out the business of all valuables they can take. With these items they leave the state. In fact, they take with them the money from the customers, the merchandise from the vendors and the reputation of the company.

A week or so later, the new president goes to work and finds the police there waiting. He's arrested, and the police waste time investigating him and the rest of the employees while the principals of the scam use the extra delay time to hide.

Using only a fraction of the stolen money, they set up shop in another state and resell the defrauded merchandise to new customers at a big discount, unloading the equipment rapidly enough to prevent word from reaching the police in the state from which they fled. After they have sold off the equipment they leave for a third state and begin new lives, much richer than they were before.

Typically, such a scam will net the principals an average of $100,000, although it could yield as much as $500,000 clear profit, with no income tax.

The Collapse

Fortunately, this scam ended differently. Some bounced checks to suppliers, persistent questions from Bill Godbout and some prying by John Craig, former editor of *Kilobaud*, forced Anderson's hand. Knowing that he might be identified by Craig, Anderson decided it was time to leave town.

He decided that the first load would leave the next night, April 25. For some reason, he decided to take along two of the employees, Eva and Joan. Both were 21, both working at WPS since early March, and both were unsuspecting. He told the two women that they were going to go to a computer school in Florida at company expense. He also told them that everything connected with this move was top-secret information. They were not to tell their parents where they were going, how long they would be gone or even why they were going. They were told that while they were gone they would not be allowed to contact their parents for any reason. In order to get them to do this, Jim cited industrial espionage as the reason for the secrecy.

In fact, it was so secret that they were told not to disclose the location of Jim Anderson's residence, which was also being used as a base for operating the scam.

Eva went home from work and started to pack. She refused to tell her parents anything except that she was going to a computer school and couldn't tell them anything more. As soon as she finished packing she left for Jim's house, where she was met by Jim and Joan. Shortly after she arrived, they left in a van full of computer equipment.

Eva's father was very upset by this sudden departure, and he was also suspicious of Jim Anderson's motives. He decided to call a relative of his, Bob Gilmartin, a highway patrolman for the department of public safety.

Together they went to Joan's house and talked to her parents. Her parents knew as little as they did about what the two women were involved in with WPS. However, they did remember hearing Joan mention that Jim's house was within sight of Magee Junior High School.

Armed with this bit of information, Eva's father and Patrolman Gilmartin drove up and down the side streets surrounding that school.

At 4 AM, April 25, they found Eva's and Joan's cars. They took Eva's car home and called Joan's parents to tell them where her car was so they could go pick it up.

At 8 AM they set up surveillance in front of Jim Anderson's residence. Shortly thereafter, Lee Anderson left the house, and they trailed her. Unfortunately, they lost sight of her at Speedway and Kolb, about three miles from where they started. They decided to stop at a nearby store so that Bob could call in to work.

Because of the circumstances, when the Pima County attorney's chief criminal deputy

heard the story, he decided to assign Investigative Agent Susan Moore to the case. Susan rapidly verified that everything at WPS was not on the up and up. She spent most of her time Friday following Lee Anderson around town.

Late Friday afternoon (or evening), Eva called her father from the Holiday Inn in Carlton, Texas. While she, Joan and Jim were driving from Tucson to Texas, Anderson had led them to believe that the things in the van were not really going to Florida at all. In fact, the things in the van were not paid for yet. Certain statements by Anderson further led them to believe they were going to stop in Texas and set up a new business and sell the merchandise in the van.

As they continued to travel across Texas, Eva and Joan learned that the things in the van had already been sold to other customers, and that Jim was not going to send the merchandise to them. Eva and Joan had thought that the equipment was legal and that they were taking it to a major buyer. They were wrong.

In short, the two women discovered that Jim Anderson intended to defraud his previous customers and his vendors, with the two of them as his accomplices.

Eva decided that she wanted no part of this and managed to sneak away to call her father for help. He told her to remain where she was while he sent the local police to place her in protective custody until he could fly out there to get her. She was back in Tucson Saturday morning.

That afternoon, Eva talked with Susan Moore and told her everything she knew. She told Susan about three self-storage lockers buildings where she believed WPS had kept merchandise, but she didn't know the exact unit numbers. Two were on Speedway and the other was on Tanque Verde.

The police watched all three buildings, along with the Anderson house, the rest of Saturday and on Sunday, but nothing happened.

On Monday the pace picked up. At 7:05 AM, one of Anderson's neighbors, whom Susan had talked to in the course of her investigation, called Susan at home and told her that people were moving things out of the house and into a van. After thanking her, Susan called her office to inform them of the activity and requested assistance. Robert Treadway, another investigator with the Pima County attorney's office, overheard Susan's request for assistance on his radio while starting for work that morning. He went to assist Susan, who, by this time, was following the van to an unknown destination.

The message was relayed to Paul Banales, one of the county's prosecuting attorneys. He left immediately with another house investigator, Ken Janes.

At this point, the action had moved and was no longer at Anderson's house, but at another located on East Julia, approximately three miles from Anderson's. Perry Pollock and his brother-in-law were observed unloading the contents of the van into the house.

When Paul finally arrived, there were two unmarked county attorney vehicles parked across the street from the house, with the passengers intently watching the activity. But no one noticed!

Susan left to maintain surveillance on the Anderson residence. However, as a result of her police radio going dead, she was forced to return to the office to obtain another vehicle. She was accompanied, at this time, by Paul, who fortunately had a walkie-talkie unit with him.



Colonel Winthrop, alias Jim Anderson (?).

Meanwhile, Perry's brother-in-law and an unidentified woman left, followed by one of the cars. She went to three banks—one right after the other—the First National Bank, the Valley Bank and the Great Western Bank. The account at the Great Western Bank was Mr. Pollock's personal account, the police later discovered.

Things were happening a little too fast for Mr. Banales' comfort, so he decided to arrest Perry Pollock and obtain a search warrant for the East Julia residence before any items were moved any further.

The warrants were served at 2 PM Monday, at the East Julia residence, and Perry was taken into custody. He was released later on his own recognizance, pending filing of formal charges.

In the house, the police found computer equipment in the living room and bedrooms; some paperwork and documents, small office supplies and equipment; and most important, they found a set of house keys. These were identified by Eva, who had accompanied the police, as belonging to the Anderson house.

Because of the evidence found at Perry's house, the police were able to obtain a search warrant for Jim Anderson's house, which was issued at approximately midnight.

Using the set of keys, they entered Anderson's residence at 1 AM Tuesday. They found reams of paperwork, documents, office supplies and equipment, and computer equipment. Numerous trash bags full of shredded documents were found. The police spent the entire night seizing everything related to WPS. In the midst of all these items, they found a contract leasing a particular storage locker, giving both the location and unit number. This contract had been signed by Joan at the request of WPS. Eva was questioned about this, and she related that Joan had, in fact, rented a storage locker for WPS at 4115 East Speedway; the lease confirmed this. Furthermore, Susan's check with the manager at the other storage locker on East Speedway revealed that Lee Anderson had rented a locker at Kolb and Speedway for WPS. Since the police could positively locate two of the three lockers, they proceeded to pick up two more search warrants, again citing "probable cause" as justification. These were issued at 10:30 AM Tuesday, May 1.

The first locker, in Lee Anderson's name, was on the far east end of Speedway Blvd. It appeared to contain many of Perry Pollock's personal belongings, but there was also equipment for circuit board fabrication and layout; artwork and photography; and photosensitive boards and developing chemicals.

The second storage locker, a 15 × 12 foot unit, proved to be the jackpot. It was crammed with computer equipment, which ranged from small RAM chips to complete computer systems. There were hundreds of disk drives, photosensitive circuit boards, chemicals and other items. The police tallied

roughly a thousand boxes removed from this storage locker, many still sealed with original packing slips included. There was so much stuff that they had to call for the department's moving van, normally used only to haul tons of illegal drugs to disposal areas.

Preliminary estimates indicated that well over half a million dollars' worth of equipment was recovered, perhaps as much as $750,000.

The third locker unit was on Tanque Verde, but because the police did not know the exact unit number and because they could not identify any of the names on the storage building's registry, they were unable to get a search warrant. The police are still watching the building for any familiar faces or unusual activities. In addition, the owners of the storage lockers are also checking those units that have defaulted on their payments to see if any of them contain anything that might belong to WPS.

Jim Anderson and Lee Anderson managed to escape with an estimated $100,000 worth of equipment, and an unknown amount of money. The police know that Jim did unload his van into a storage locker in Texas; however, Anderson was one step ahead of the police. By the time federal authorities were called in to assist in obtaining a warrant for the Texas locker, Anderson had already cleared it out, leaving only a few boxes of equipment.

The Jig Is Up

There is a good ending to this. As of June 2, Jim and Lee Anderson were arrested in Honolulu, Hawaii, with approximately $11,000 cash. Jim was actually in the process of dying his hair when the FBI broke into his apartment to arrest him.

As a final wrap-up, Jim is being arraigned in California on his outstanding federal warrant for escape, while Lee is being returned to Tucson to be arraigned on charges stemming from the operation of WPS.■

Anyone having any additional information on WPS is requested to contact either:

John Zemblidge
Postal Inspector
Box 26070
Tucson AZ 85726
or
Paul Banales
Deputy County Attorney
Pima County Attorney's Office
111 West Congress St.
Tucson AZ 85701
(602) 792-8411.

The names of WPS employees have been changed in the interest of personal privacy.

The Pima County attorney's office has reviewed this article and OK'd it for publication.

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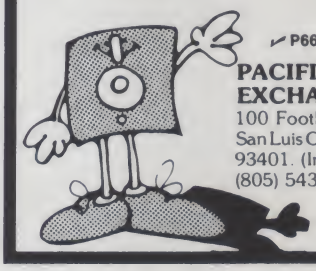
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Business Software Made Easy

If you want to write *business software, you should* read *this article.*

So, you'd like to write some business software? It isn't too difficult, so why play games when your micro could be making a few bucks. The problem in writing good business software is that programmers are neither accountants nor businessmen, and vice versa. Without trying to be expert in all these areas, this article will point the would-be software person in the right direction and perhaps give away a few tricks of the trade in the process.

As you approach this subject, keep in mind that there are several different ways to solve almost any problem. Although the CPAs, IBM and all the other big professionals do a great job for big business, it is OK if we think a little smaller for the small business—but not quite as small as some advertising would have us believe. No matter how small the business, the software system must be fast, accurate, operator proof and produce good, readable hard-copy output. But we can cut a few corners and frills.

Defining Software Needs

The businessman who begins to think about computers most often mentions payroll and inventory, two aspects that might better be left until he and the computer are better acquainted. Also useful to him are check registers and mailing lists (easy), general-ledger accounting (tougher), accounts receivable and a lot of specialized items such as payment schedules and investment returns.

All this can be done, of course, with pencil and paper; the computer is simply faster and more accurate and becomes cost effective only above a certain volume. Cost effectiveness is the businessman's bible, and sometimes computerizing just isn't worth the trouble and expense. If he can't afford more than a stripped-down game-playing machine, he can't afford any decent software either.

There is a lot of software on the market, some good and some bad, costing from $15 per program to $15,000 for complete packages. The point is that no one program or package will satisfy the needs of even the smallest business or of all businesses in the same category. Most will need individual customizing, at the very least. Some professionals, too, such as doctors, will be mainly interested in accounts receivable, while a parts house might get by with only a decent inventory program. All of these needs require legitimate business software, and the guy doing this for dollars can pick and choose, leave out the trivia, beef up the important stuff or even write it all if he has the time and the skill.

In any event, the useful software package will consist of several programs and data files, compatible with one another and linked together in some manner such as sharing a common data base. Fig. 1 outlines an actual small-business general-ledger system. Considering all of the paperwork of a typical enterprise, the general ledger is neither the most difficult nor the easiest to do, but is always essential. Its purpose is to account for the money.

In accounting jargon, a journal is a diary-like listing of all transactions. At the end of a specified accounting period, the entries are posted, that is, copied into ledgers, where they are grouped by type rather than in chronological order. Each transaction gets entered at least twice, hence the term double-entry accounting. For example, a cash sale increases the cash and decreases the goods on hand.

At the level we are speaking of, accounting consists of first making the original entries, then separating them by specific account type and, finally, manipulating the result into some meaningful form such as a profit/loss report. Fig. 2 shows the flow of entries just described. At this point it should be apparent that, whether done by hand or by computer, some kind of sorting is essential.

In *Sorting and Searching*, Donald Knuth estimates that 25 percent of business-computer time is devoted to sorting. Some guesses place the figure even higher. Volumes have been written on the subject; we can skip the exotic math used in sorting IRS records, for example, but we should be prepared to do some sorting.

Reordering a list of a few hundred simple numbers should not pose any great problem. Most BASICs have a means of extracting the first character of a string, which may then be converted to a number for rough alpha sorting. To do a more thorough job, there are available little code books that assign a unique number to each name.

So much for ascending or descending order; it is also useful to sort or, more precisely, to group items having some common characteristic, such as an account number. It is a business convention to use a chart of accounts, which in a simple example might code all cash transactions, all charges, all inventory, and so forth.

Sorting

To the accountant, each transaction is a journal entry. To the programmer, each such entry is a record. A collection of these can be called a journal or a transaction file. Each record contains several different pieces of information, which we'll agree to call fields, and

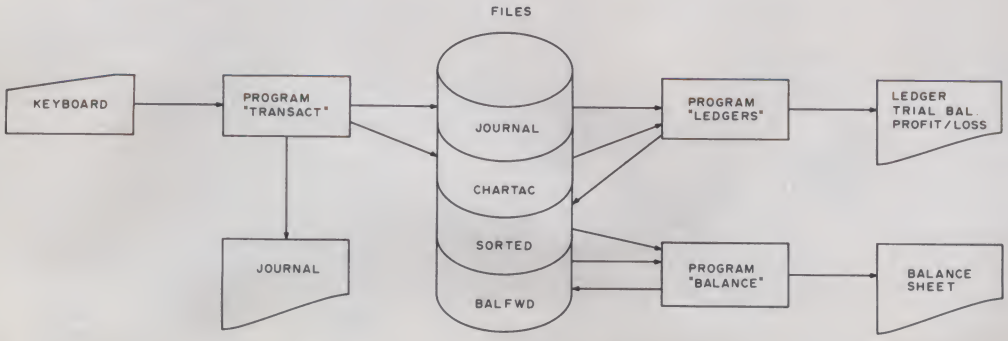


Fig. 1. A simple general-ledger system.

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several records of like type make up a file. Fig. 3 outlines a typical general-ledger record as it would appear in the transaction file. Notice that the date is one field, the account number another and so on. Why is it done this way?

The programs are going to be reading this file—probably many times—as a series of numeric and string variables. This particular record would be read as A,D$,B,A$,D,C. The fields are kept separate so that we can extract the date field, D$, and use it in sorting by date.

In this case, A is the account number and will be used to route the journal records into the proper ledger account. This is done by reading the first number from a list of the chart of accounts—either out of another file or out of an array—then, in turn, comparing each record with that number. This is repeated with each account number. During the process, the records that are identified may either be printed out in order or written into a sorted file, or both. This is not a fast method of sorting, but I doubt that your printer can stay ahead of it. (See Fig. 4.)

In addition to sorting, we have been speaking of printing and of repeatedly reading files. This, in effect, establishes a minimum hardware configuration for running business software. Operators can't afford the hassle of wading through audio cassettes looking for a particular record, and the businessman who doesn't want his records on paper should have disappeared by now. A good printer is essential, along with either a disk or a sophisticated tape system; a single mini-floppy will do wonders, but even 64K of RAM and the world's fastest CPU offer no particular advantage. There is little actual computation involved, but a heck of a lot of searching and printing.

In fact, these disk files are the complete and final answer to modern business processing. In addition to their main purpose, the storing of records, they may be used in a lot of ways to make everything run smoother. For example, the numbering of files usually begins with 1, but the file addressing starts at zero. If records are 100 bytes long, there is a 100-byte space at the start of each file for maintaining convenient access to often used housekeeping data, such as dates, headings and information about the file itself.



Fig. 2. Transaction flow.

One typical use is to enter the date each day when the machine is turned on and use this to properly head up each document printed that day. Fig. 5 shows a way of using the file space just described.

Operation

Having briefly covered some general concepts and a few details, let's go over the actual operation of the general-ledger system in Fig. 1. I hope that at this point it makes more sense than it did at first glance.

The operator begins by loading the program, Transact. This program serves several functions. One part merely services the chart of accounts and will seldom be used after the reference file, Chartac, has been established. The essential activity in this program is entering transactions as they occur, in chronological order, in the file Journal. At the end of some period, such as after each month, this file will presumably contain all the raw data necessary to complete the rest of the general-ledger accounting. It is almost the only manual part of the operation.

One of the operator options in Transact is to call for posting. When this is done, the program calls Ledgers and sets the posting process in motion. This program reads the file Journal, sorts or groups the records according to their account number, prints them out and writes the totals of each ledger category into the file Sorted. Upon completing this, it takes a trial balance (an essential accounting function). If the balance is zero, Ledgers will proceed to crank out a profit/loss statement for the period, using information stored in the file Sorted.

The final program of the set is Balance; this also works from the file Sorted to produce a balance sheet. It also identifies and carries forward, in the file Balfwd, the accounts that have to be preserved for the next accounting cycle.

In summary, there are three programs and four files. The operator manually enters raw data in the first file; with very little human intervention, the programs then derive from this information all the remaining files and reports. The machine does the work, and this is as it should be in the modern world.

Documentation

Remember that the operator may not have the slightest interest in how the program works and may consider its use just another chore. You'll be surprised, too, how soon you can forget the details of a program you are not using constantly, and how obscure it might seem to someone else called in to debug the system. In addition to plentiful remarks in the program itself, a detailed instruction manual is a must for any business software system.

When you think it is perfect, try it on an inexperienced operator and then rewrite it. Try entering bad data and then build in traps to preclude such disasters. Imagine all the things that can go wrong during "normal" operations (such as power failures) and carefully explain how to recover.

Business software can be as challenging and as much fun as any other kind of programming. It's a good answer to "What do you do with your computer?" and you just might get rich doing it.■

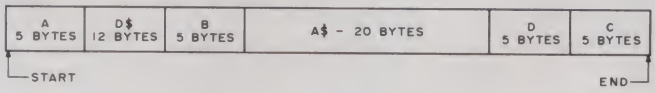


Fig. 3. A typical file record.

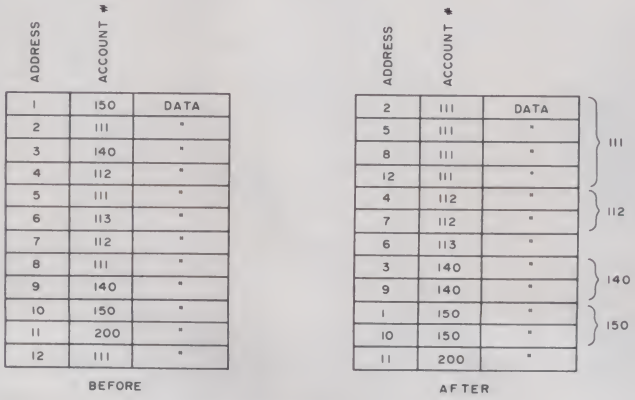


Fig. 4. Records before and after sorting.



Fig. 5. Temporary file at 0.

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If you are using KIMCTR (*Kilobaud MICROCOMPUTING*, May 1979, p. 34), you will be interested in this low-cost scheme for measuring capacitance. If you are not using KIMCTR, this may give you the urge to do so. If you have no intention of using KIMCTR but do want to measure capacitance, read on because this circuit can be employed with other microprocessors, counter/timers or just an oscilloscope alone.

I have many capacitors on hand—most of them used—that I have acquired from various sources. Many capacitors have unreadable markings; some have in-house markings that tell me nothing. So for some time I have thirsted for a simple, low-cost way to measure capacitance. There are also times when I need to know the value of a capacitor to some reasonable accuracy. More often I simply want to match capacitance. This circuit meets all of these needs.

The Concept

If you charge a capacitor at a constant rate, its voltage will increase linearly with time. If you properly scale the charging current and measure the time required for a precise, one-volt increase, the value of the capacitance will be proportional to the transition time.

In this scheme I employ four switch-selected constant currents of 1, 10, 100 and 1000 μA. A low-high limit comparator detects a one-volt change in V_c and provides a pulse out. The pulse width is measured and displayed on KIMCTR. It may also be observed on an oscilloscope or measured on any suitable timer. Measurement span is 1 pF to 999.999 uF on KIMCTR, with four ranges.

Parts cost is low—anywhere from about $10 to $50, depending on what you have on hand and where you buy needed items. You can use an unused flip-flop and exclusive OR gate in the KIMCTR circuit to save two ICs.

Though the concept is simple, some effort is required to ensure accuracy of the measurements. Access to a 4½ digit DVM with 10 nA and 10 μV resolution is needed for calibration. There are few constraints on construction; I built mine up on perfboard. The primary concern is to keep wiring short in the capacitor circuit to minimize stray capacitance. You should exercise the usual care with the comparator wiring to minimize coupling between input and output. I used five-way banana jacks for connection to Cx.

$$v_{cn} = \frac{I}{C} t_n$$

where I = the charging current from the constant current source, and C = units of capacitance, from which

$$C = \frac{I}{v_{cn}} t_n$$

if v_{cn} can be forced to unity, this reduces to

$$C = I t_n$$

I is then scaled to yield C in units of time as pF, nF or uF

Example 1.

Basic Principles

An ideal capacitor that is charged from a constant current source will develop a voltage that increases linearly with time. Assuming a zero initial voltage and commencement of current flow at start time, t_0, the voltage at any later time, t_n, is shown in Example 1.

Fig. 1a shows a constant current source charging a capacitor. The current must be truly constant over some defined range of v_c for v_c to be a linear function of t_n.

In Fig. 1b, C is bypassed with a shorting switch. A voltage comparator is connected across C. The non-inverting input is connected to C. The inverting input is connected to a stable voltage reference. At start time t_0, the switch is opened and a voltage is developed across C. At some later time, t_1, $v_c = v_R$, and the comparator output changes state. If $V_R = 1.000$ volt the differential time will be proportional to C. However, this is not a practical circuit because the switch will have some resistance and the initial value of C will not be zero.

The effects of switch offset are eliminated in the low-high limit detector of Fig. 1c. Resistor R1 is selected such that the low-limit voltage, v_{c1}, will be greater than any expected offset. Current source I2 maintains a precise 1.000 volt drop across R2. Then $v_{c2} - v_{c1} = 1.000$ and $C = I(t_2 - t_1)$.

The outputs of the two comparators in response to the rising capacitor voltage are diagramed in Fig. 1d. Charging begins at time t_0. The low-limit detector changes state at t_1, the high limit at t_2.

We need a scheme to measure the difference time. The exclusive OR gate provides a solution. Its truth table is provided in Fig. 1e. The gate output will be high in the interval $t_1 - t_2$; at all other times, it will be low. The pulse width is the value of C.

The Transistor Current Source

A single-transistor current source provides the capacitor charging. The basic current source circuit is shown in Fig. 2. This simple circuit will source a consistent constant current with a high degree of stability. The transistor is operating in a dc common-base configuration. The voltage reference, VR, establishes a constant voltage between the base and emitter. The emitter current IE must adjust itself so that the product IE · RE = VR.

There are two inherent features of the common-base mode that contribute to its utility as a constant current source: The leakage current, Ico, of the collector-base diode is not amplified by the transistor, and the output resistance of the transistor is the dynamic source resistance of the collector. For small currents this will be many megohms.

Care must be exercised in the design and adjustment of the current source, as the accuracy of the measurement is dependent on both the absolute value of the charging current and upon its remaining constant throughout the measurement interval.

The Measurement Circuit

The complete circuit is shown in Fig. 3. I have identified the

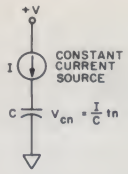


Fig. 1a. Capacitor charging from a constant current source results in a linear voltage that is proportional to current and time.

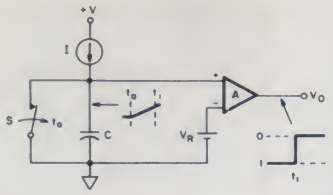


Fig. 1b. Addition of a shorting switch and comparator with a reference input provides a step output at time t_1 that is proportional to the value of C.

three functions of the circuit as precision current sources, capacitor charge/discharge control, low-high limit detection.

Precision Current Sources

There are two current source circuits: The first supplies one of four switch-selected capacitor-charging currents; the second establishes the reference voltages for limit detection. The Motorola 1N 4565 is a temperature-compensated reference diode, specified for a temperature coefficient of .01%/ °C drift at a diode current of 500 μA. CR1 is a diode-connected transistor. Its function is to track the base-emitter diode of transistor Q1.

In constructing the circuit, I first assembled the current sources and made a preliminary adjustment of the current for each switch setting. A final adjustment must be made when assembly is completed. I used a four-position DIP switch for range selection. I used style RV6, 1/2 Watt, single-turn composition potentiometers with good results. I used them because I have a number on hand; if I were to buy a new one, I would purchase a cermet trimmer, such as the Beckman series 66. I used carbon resistors, but for best long-term stability, metal or cermet film would be preferable.

Leakage current measurements of the transistor diodes should be made to ensure good devices. Leakage should be about 10 to 20 nA. I made all measurements with a Keithly model 179, 4½ digit DVM. Since Q2 operates at a relatively large current, a 6.2 volt zener and IN914 compensating diode are a satisfactory reference, assuming room temperature use.

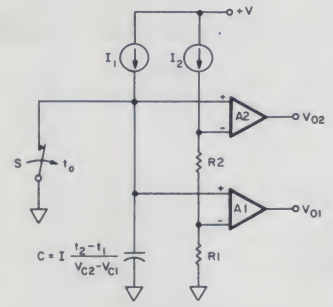


Fig. 1c. Two comparators in a low-high limit detection circuit eliminate error due to switch offset.

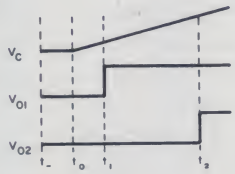


Fig. 1d. Timing diagram for the low-high limit comparator circuit.

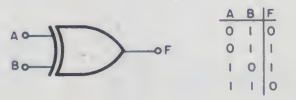


Fig. 1e. Exclusive OR gate and logic table.

Capacitor Charge/ Discharge Control

Capacitor charging is controlled by transistor Q3. This switch has two functions: to discharge the capacitor at the end of the charging cycle and to limit the maximum voltage across Cx to about 2.5 volts.

The cycle is controlled by the counter reset pulse. You may wonder why a flip-flop is in the circuit. It takes a certain length of time for Cx to discharge. Large capacitors, and electrolytics in particular, require a longer time to discharge than is available between counting intervals. The 4013 sets and resets Q3 through the LM339 for alternate charge and discharge sequences. The LM339 assures adequate drive for the transistor.

Though measurements are made at alternate counting intervals, two sets of data will appear on the display. This is because discharging the capacitor yields a pulse that is also measured. There is no confusion between the two; the value measured is large compared to the discharge time. For many small capacitors the discharge time will read zero.

Low-High Limit Detection

The primary problem I encountered with this circuit was oscillation of the low-limit comparator. The oscillation occurs because the input is a slowly rising ramp. The conventional technique for handling this is to provide hysteresis with positive feedback from a resistor to the + input. This approach cannot be used because the feedback current is then summed into the charging current. A 10M resistor will contribute about 1 μA of current, which is unacceptable.

Since I could not eliminate the oscillation, I decided to use it to my advantage. The capacitor voltage builds up with time until it is equal to the voltage across R20, about 750 mV. The comparator output then jumps from low to high. That is what we want, but unfortunately it doesn't stay there. Various factors cause the output to jump back and forth until the rising input passes through the transition region, allowing the output to stabilize in the high state.

The network of C3, CR6 and R23 conducts the initial output rise around to the + input to force a small rise in voltage, sufficient to maintain the high output state. The diode forces the capacitor to discharge through the 1M resistor. The long discharge provides time for the input to rise sufficiently to maintain the output.

A clean leading edge of the output pulse is essential. KIM-CTR captures the first pulse it sees; if that is a 3 μS spike, that is what you read. I read a lot of them before I solved the problem. The solution has been very effective.

The network is not needed on the high-limit comparator. KIM-CTR will detect the first transition and stop the count. Output pull-up resistors R21 and R22 are both bypassed for equal reset times.

R19 and R20 should be metal-film resistors for low-noise and long-term stability. The absolute values are not critical because the 1.000 voltage across R19 must be obtained by an adjustment of R10 when the circuit is fully assembled.

Measurement Accuracy

Two factors affect the achievable measurement accuracy. One is internal, that is, the accuracy with which the current sources are adjusted and their stability, both long and short term. The other is external in that capacitor leakage will distort the measurement.

The LM339 inputs contribute a bias current that sums in with the charging current. You can measure this current by simply connecting your multimeter across the Cx terminals with the four DIP switches open. I measured 115 nA. Fortunately, this current is nearly constant, with a positive temperature coefficient (doubles each 10 °C rise in temperature).

To perform the final current source adjustment, leave the meter across the Cx terminals and adjust R2, R4, R6 and R8 for a precise 1, 10, 100 and 1000 μA,

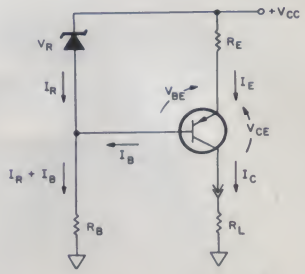
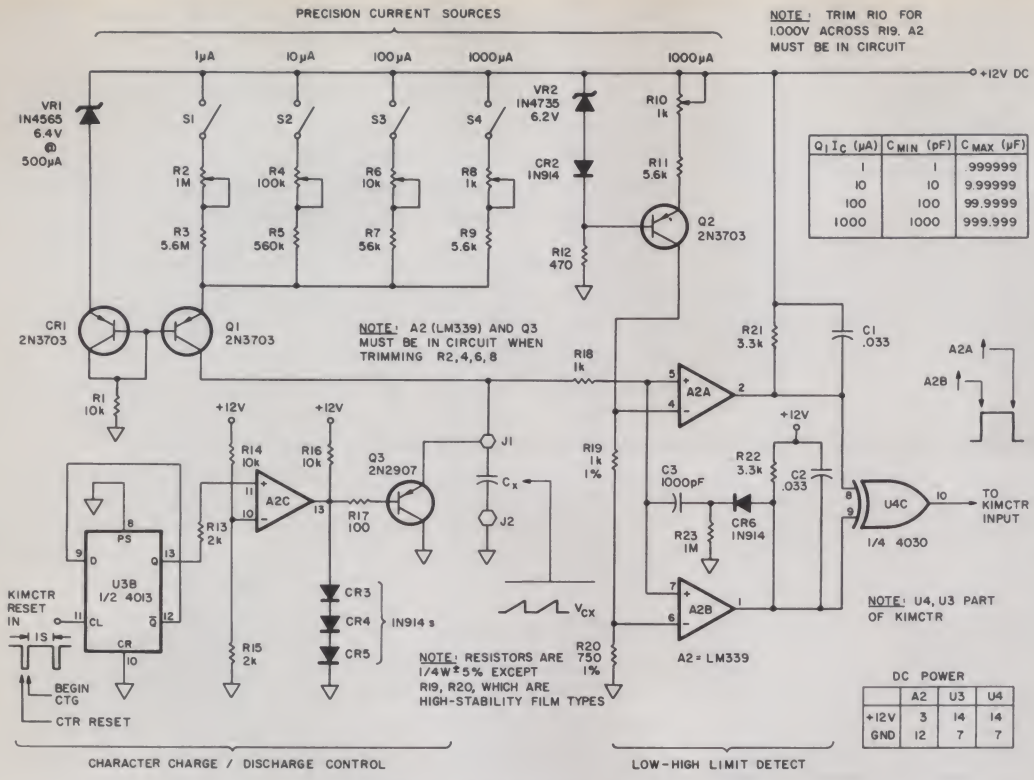


Fig. 2. Single transistor constant current source. For a given value of V_R, the collector current is determined by the resistance R_E.



$Q_1 I_C$ (μA)	C_{MIN} (pF)	C_{MAX} (μF)
1	1	.999999
10	10	9.99999
100	100	99.9999
1000	1000	999.999

DC POWER

	A2	U3	U4
+12V	3	14	14
GND	12	7	7

Fig. 3. The complete circuit schematic of the capacitance meter.

respectively. Close only one switch at a time; do not sum the sources.

With some experience you can calibrate the comparator bias current for the measurement of small capacitances. In theory you can measure a 1 pF capacitor with the 1 μA current. In practice I found 10 pF to be the minimum. However, you can still measure a 1 pF capacitor with a simple trick.

I stripped two conductors from a 10-conductor ribbon cable, terminated one end with mini clips and then clipped bits off the other end until it measured 10 pF. With this calibrated test lead I can measure any value of small capacitance. I connected a 115 pF mica capacitor and left KIMCTR running for five days of continuous measurement. From time to time, I looked at the display.

I had performed the final calibration adjustments on one of our typically balmy La Jolla days when my home lab was close to 70°. During the five-day period the temperature increased. I observed a positive temperature coefficient of about 1/3 pF/°F. The maximum I observed in the display during the five days was 118 pF. It never dropped below 115 pF.

Capacitor leakage lengthens the measurement time; the capacitor looks larger than it really is. For this reason measurements should be made at the highest feasible current. I use four digits as a target; the 4th digit typically shows some jitter. With careful adjustment of the current sources, you should achieve measurement consistency of 3 percent or better between ranges with low leakage capacitors. Absolute accuracy of better than 5 percent should be achievable. Generally speaking, all types except ceramic disks and aluminum electrolytics are measurable with fairly decent accuracy.

An assortment of readings from mylar and mica capacitors showed a scatter ranging from right on to about ±3 percent. If you want to look at the capacitor charging ramp with your scope, be sure to use a X10 probe.

Overall, I am pleased with the KIMCTR capacitance meter. I consider it a real bargain in terms of value per dollar of cost and the effort to put it together. I'll get a lot of good use from it. I think you will too.■

Reference

C. S. Pepper, "Measure Capacitance Quick and Easy with this Low-Cost Circuit," *EDN Magazine*, February 5, 1979, p. 130.

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- ☐ALL CAPS
- ☐The "Learning Machine" . . . *math tutor program*
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- ☐The Twelve Days of Christmas
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- ☐ **Software Keyboard Interface**
- ☐ **Morrow's I/O Cassette Board**
- ☐ **It's Your Hobby!**

February 1978*

March 1978

- ☐ **Build the "Simple Computer"** . . . *a home-brew 8080*
- ☐ **Hardware Program Relocation, Part 2**
- ☐ **State Capitals**
- ☐ **Customized MIKBUG**
- ☐ **TV Typewriter Update**
- ☐ **Foolproof Cassette Operation**
- ☐ **Number-Crunching Time**
- ☐ **Super Terminal!** . . . *interfacing the Burroughs 9350-2*
- ☐ **Consumer Computer, Inc.**
- ☐ **Programmed Instruction Made Easy: Tiny PILOT, Part 1**
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- ☐ **Backup Techniques** . . . *how fail-safe is your system?*
- ☐ **Small Business Software, Part 2**
- ☐ **Expand Your KIM!** . . . *Part 4: a TTY substitute*
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- ☐ **The Axiom EX-800**
- ☐ **Tiger Trouble!** . . . *TI programmable-calculator safari*
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- ☐ **A Different Approach to HI-LO**

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May 1978*

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- ☐ **Two Hobbies: Model Railroading and Computing**
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- ☐ **A Tour of the Faire, Part 2**
- ☐ **Taming the I/O Selectric** . . . *Part 2: software*
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- ☐ **MIKBUG with Muscle!**
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- ☐ **An S-100 Front Panel Replacement**
- ☐ **Home-Brew Z-80 System** . . . *Part 2: CPU and memory board*
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- ☐ **Improvements Make the Difference** . . . *SWTP's new system*
- ☐ **Simple and Low-Cost PROM Programmer**
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- ☐ **DOCUFORM: A Word-Processing System for Everyone!**
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- ☐ **The Amazing 1802**
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- ☐ **The Heath/DEC Connection** . . . *Part 1: overview*
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- ☐ **A Useful Address List Program**
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- ☐ **The Art of Generating Expense Reports**
- ☐ **Deep, Dark Secrets of the TRS-80 (Level I)**
- ☐ **Interfacing the Elf II**
- ☐ **The Care and Feeding of Cassette Tapes, Part 1**
- ☐ **Kilobaud Klassroom** . . . *No. 15: computer I/O III*
- ☐ **Raster Scan Graphics for the 6800** . . . *Part 2: the software*
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- ☐ **TSC Text Editor**
- ☐ **Spelling Bee**
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- ☐ **There Is a Better MIKBUG!**
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- ☐ **Sharing Scheme for RS-232 Channels**
- ☐ **Scratched Diskette?**

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- ☐ A Service Bureau for Hobbyists
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- ☐ Keeping Ma Bell Happy

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- ☐ Block-Structured Language for Microcomputers
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- ☐ Computerized Climate Control
- ☐ Music, Maestro!
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- ☐ Inventory Control with the TRS-80
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- ☐ DOTS
- ☐ The Apple Speaks—Softly
- ☐ Super Mastermind
- ☐ TRS-80 Level II Reference Manual Index
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- ☐ SWTP CT-1024 Mod
- ☐ Who Sells Software?
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- ☐ KIMCTR
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- ☐ A TRS-80 Cross-Index
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- ☐ An All-in-One Interface

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- ☐ "Monitor"
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- ☐ TVBUG
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- ☐ A Handle on Programming
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Status of Homes/Auto Expenses 4K; Order No. 0012R.

BUSINESS PACKAGE I Keep the books for a small business with your TRS-80 Level I 4K. The six programs included are:
- **General Information**—The instructions for using the package.
- **Fixed Asset Control**—This will give you a list of your fixed assets and term depreciation.
- **Detail Input**—This program lets you create and record your general ledger on tape for fast access.
- **Month and Year to Date Merge**—This program will take your monthly ledger data and give you a year to date ledger.
- **Profit and Loss**—With this program you can quickly get trial balance and profit and loss statements.
- **Year End Balance**—This program will combine all your data from the profit and loss statements into a year end balance sheet.

With this package, you can make your TRS-80 a working partner. **Order No. 0013R $29.95.**

Demo I 4K; Order No. 0020R.

Destroy All Subs/Bomber/Gunboats 4K; Order No. 0021R.

PERSONAL FINANCE I Let your TRS-80 handle all the tedious details the next time you figure your finances:
- **Personal Finance I**—With this program you can control your incoming and outgoing expenses.
- **Checkbook**—Your TRS-80 can balance your checkbook and keep a detailed list of expenses for tax time.

This handy financial control package for the home requires only a TRS-80 Level I 4K. **Order No. 0027R**

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Space Trek III 4K; Order No. 0031R.

Fun Package I 16K; Order No. 0037R.

Hex Pawn/Shuttle Craft Docking/Space Chase/ Sea Battle
16K; Order No. 0041R.

BUSINESS PACKAGE III This package can change your TRS-80 into a full working partner for any businessman:
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- **Discount and Commission Percentages**—Let your computer figure out mark up and discount calculations, sales tax and more. This is a perfect time saving package for any small business.

For the TRS-80 Level I 4K. **Order No. 0061R**

Level I and II

Basic and Intermediate Lunar Lander
4K; L.I, 16K L.II; Order No. 0001R.

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Backgammon and Keno 4K L.I, 16K L. ii; Order No. 0004R.

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Electronics I 4K L.I, 16K L.II; Order No. 0008R.

Golf/Crossout 4K L.i, 16K L.II; Order No. 0009R.

Air Flight Simulation 4K L.I, 16K L.II; Order No. 0017R.

Oil Tycoon 4K L.I, and L.II; Order No. 0023R.

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SANTA PARAVIA AND FIUMACCIO The year is AD 1400, and you are the ruler of a tiny Italian city-state. You are ambitious by nature and intend to build your little city-state into a powerful kingdom.

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Life was short back then, and you'll have only a limited amount of time in which to build your kingdom. The lives of your serfs will depend on your decisions. If they are wise, then your city-state will grow and you will acquire loftier titles. If your rule is incompetent, your people will starve and your city-state may be invaded by your neighbors.

You can play the game yourself, or set up the tournament version, which allows up to six players at a time to compete. Either way, you're sure to find your route to the throne a challenging and rocky road.

How will you rule your kingdom? Will you be a benevolent ruler—an iron fist in a velvet glove—or will you become unscrupulous and follow the example set by Niccolo Machiavelli in his book on government, *The Prince*? Only *you* can answer that question—with Santa Paravia and Fiumaccio. **Order No. 0043R**

Level II

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16K; Order No. 0024R.

RAMROM PATROL



The Ramrom probe ships are steadily advancing. You've only a limited amount of power, and you're a long way from home, but as a member of the Ramrom Patrol, your mission is clear: Destroy the Ramrom probes at any cost. Manage your ship efficiently and effectively, and you just might complete your mission and still have enough fuel to reach your base. If, on the other hand, your "shot" leaves something to be desired, you're sure to wind up in the hands of the dreaded Ramromians—whoever they are. But don't worry—getting there is all the fun!
- **Klingon Capture**—Your mission is to capture a Klingon battle cruiser intact—no mean feat by anyone's standards. In fact, the only known way to bring it home alive is to destroy any stars that happen to surround the cruiser, thereby rendering it incapable of moving. But don't expect the cruiser to sit in one place and allow itself to be caught. You'll have to keep a watchful eye on your screen for the scanner reports and keep your fingers crossed.
- **Tie Fighter**—The object of the game, in this simulation of a battle between an X-wing and Tie fighters is to shoot down as many of the enemy as possible within the allotted 200 time units. You fly the X-wing fighter and, if you aim carefully and shoot quickly, who knows . . . you just might wind up as the next hero of the revolution—or at least your living room! **Order No. 0028R**

TRS-80 UTILITY II The second in a series of programs designed to help the programmer, Utility II will add unprecedented flexibility to your BASIC programs, by allowing you to combine them with other BASIC programs or with machine-language programs or routines.
- **CFETCH**—After you have renumbered your programs using RENUM (see Utility I) you can use the CFETCH program to merge your consecutively numbered BASIC programs. CFETCH also allows you to search a program for its file name, without merging it with the resident BASIC program.
- **CWRITE**—This powerful program allows you to merge one or more machine-language programs with other machine-language programs or with a BASIC program. Merged programs can then be loaded with a single command. CWRITE also makes it possible for you to obtain a general checksum (impossible to do when CLOADing a BASIC program) and also allows you to load programs in non-consecutive locations within the memory.

Order No. 0076R

TRS-80 UTILITY I



Tired of having your best programming efforts frustrated by the lack of tools? These two powerful TRS-80 utility programs should be stock equipment in every programmer's "toolbox."
- **RENUM**—Never again will you have to leave out that new routine or feature because you lack available line numbers. RENUM will renumber your Level I or Level II programs by whatever increments you specify—including all GOTOs and GOSUBs!
- **DUPLIK**—One of the first laws of computer programming is to retain duplicate copies of all of your programs. With DUPLIK, you'll be able to make and/or compare copies of BASIC, source assembler, and machine-language programs. If you have more than one program on a cassette, DUPLIK will enable you to load and save them all by using a single command—without merging. And all of the above can be performed on your Level I cassettes while you're using your Level II machine!

Order No. 0081R

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PET**

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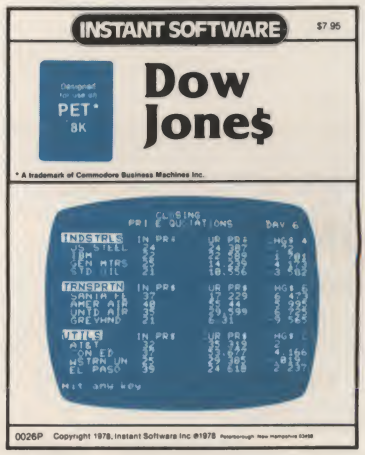
MORTGAGE WITH PREPAYMENT OPTION/FINANCIER These two programs will more than pay for themselves if you mortgage a home or make investments:
- **Mortgage with Prepayment Option**—Calculate mortgage payment schedules and save money with prepayments.
- **Financier**—Calculate which investment will pay you the most, figure annual depreciation, and compute the cost of borrowing, *easily and quickly*.

All you need to become a financial wizard with an 8K PET. **Order No. 0006P**

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MIMIC

How good is your memory? You can find out with the Mimic program, and for a fraction of the price of similar games being offered on the market today.

Your PET will flash a sequence of figures on the screen and ask you to repeat them in the same order. It may sound easy, but there are five different programs, one of which is sure to keep you going until you're ready to throw in the towel. It's fun, it's bound to improve your memory, and it's even programmed for optional sound effects; all you need is an amplifier and a speaker.
Order No. 0039P

Penny Arcade 8K; Order No. 0044P.

Arcade II 8K; Order No. 0045P.

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MATH TUTOR I The Math Tutor I package is designed to help younger children learn the concepts of mathematics. It uses the technique of positive, immediate reinforcement. When the child enters a correct answer, he or she is rewarded with the opportunity to move a spaceship, cast a magic spell, or rescue a man from a most unfortunate fate. By using this method of positive reinforcement, children will learn to associate mathematics with pleasant experiences, as opposed to the stark reality of numbers that has driven so many pupils to an early dislike of math. The program also provides the opportunity for parents to indulge in a unique learning experience with their children, while introducing them to the exciting world of microcomputing. Teachers can also use the program in a classroom setting to provide that extra incentive. Math Tutor I contains the following programs:

- **Hanging**—A variation of the traditional game of Hangman. In Hanging, students must spare the graphic character's "life" by correctly answering the questions posed by the computer.
- **Spellbinder**—The student is cast as a magician competing against another magician who's controlled by the computer. He must answer the questions about fractions correctly in order to cast magic clouds, fireballs, and other spells at his rival.
- **Whole Space**—Students are given the opportunity to lead an attack on an evil planet. Every time a correct answer is given to a math problem posed by the computer, he can move his ship closer to his goal. Every wrong answer gives the enemy an opportunity to fire back.

Note: the Hanging program requires Applesoft II BASIC. The Whole Space and Spellbinder programs can run in integer BASIC. **Order No. 0073A**

Math Tutor II Applesoft II + 20K Order No. 0098A.

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1063 West El Camino Real, Mt. View

Byte Shop of Sacramento
6041 Greenback Ln. Citrus Heights

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2927 28th St. S.E. Kentwood

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29673 Northwestern Hwy. Southfield

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Artco Elect.
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Erie Computer Co.
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Your TRS-80 microcomputer displayed the word SORRY all too often as you were entering the last part of a BASIC program into its 4K memory (SORRY indicates that no more memory is available). So you deleted all the REMARK statements, used all possible abbreviations and finally got the program to fit into the 4K memory space.

Being only human, you immediately found errors in the program as you tried to RUN it. Then you were faced with the formidable task of debugging a faulty BASIC program full of colons and abbreviations with no helpful REM statements. (Radio Shack Level I BASIC allows the user to pack multiple statements onto one line if colons are used between statements. Additionally, commands such as PRINT, FOR and GOTO can be abbreviated as P., F. and G., respectively; the LET command can be omitted *completely.)*

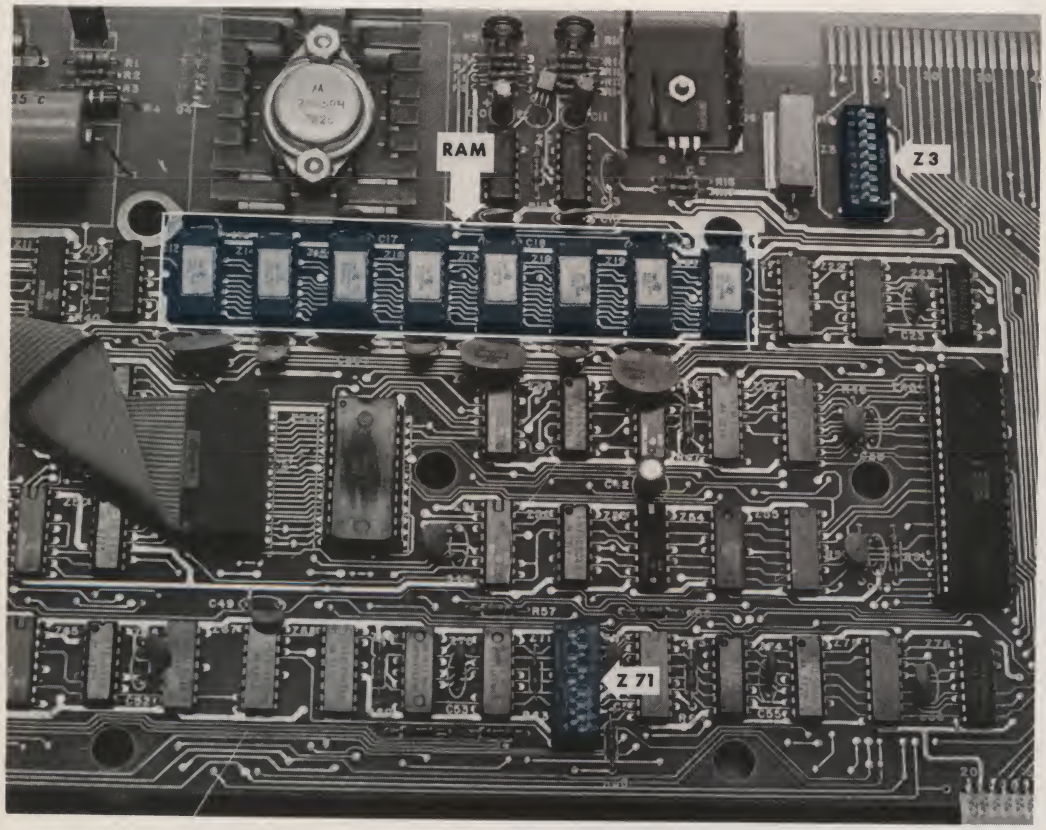


Photo 1. Component side of the computer PC board. The locations of ROM, RAM and the two DIP switches are shown.

If you haven't experienced this scenario, you soon will. The easiest solution to this problem is to increase the memory capacity of your machine to 16K of RAM (random access memory). You *can take* your computer-keyboard assembly to the nearest Radio Shack store, which will make this expansion for you at just under $300, or *you can do it* yourself for under $100. This article will give you instructions for the do-it-yourself technique.

Introduction

If you were lucky enough to get your 4K program functioning, you probably ran into more trouble down the road if you had your 4K machine converted to Level II BASIC. As Level II programs are recorded onto cassette at a higher baud rate, all of your Level I program tapes must be converted to the faster Level II. When Radio

Shack installs Level II BASIC in your machine, they supply cassette tapes that will perform this job. However, the programs on these cassettes take up some memory space and make it impossible to convert your longer programs to run on your Level II machine.

Radio Shack recommends the installation of 16K of memory to solve this problem. I recommend installing both Level I and Level II BASIC in your machine. That's right, use the Level I BASIC ROM (read only memory) with Level I tapes and switch to Level II BASIC ROMs for Level II tapes. You will find this a convenient means of retaining long Level I programs that would not run on your Level II machine because of memory requirements for tape conversion.

The second part of this article deals with the installation of Level II BASIC and the simple modifications required to retain the Level I ROM. You realize, of course, that these modifications give you "Level III" BASIC. Doesn't Level I + Level II = Level III?

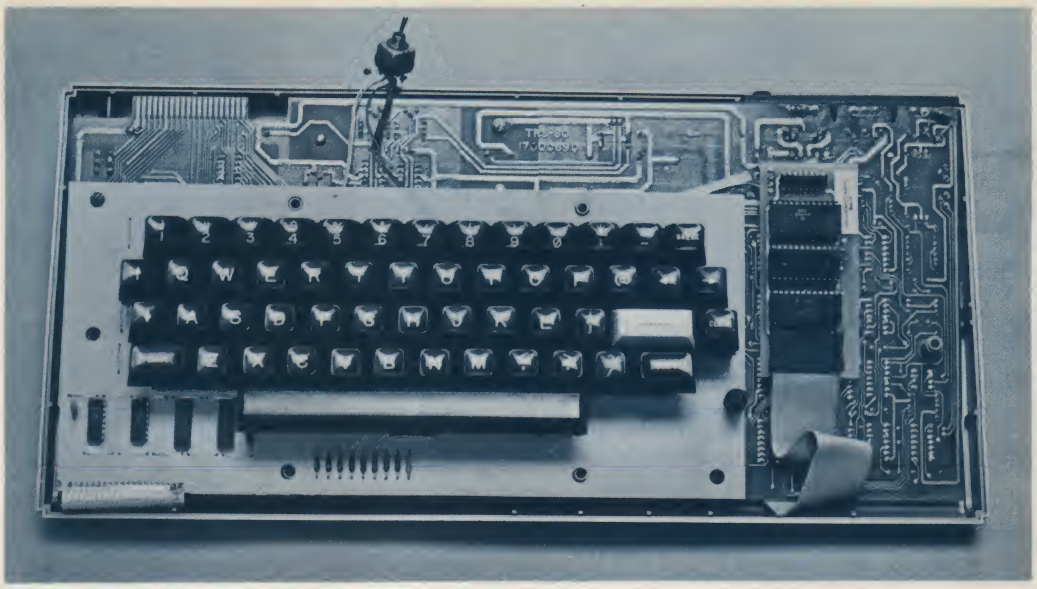


Photo 2. Keyboard and subassembly. The correct placement of the Level II ROM board is illustrated.

Installation of 16K RAM

The 16K memory-expansion technique is simple. The only tools required are a small flat-bladed screwdriver to be used as an IC (integrated circuit) remover and a Phillips screwdriver to open the case of the computer-keyboard assembly. The eight 16K × 8 bit memory chips can be ordered from any one of several suppliers who advertise in the pages of *Microcomputing* or from a local electronic parts supplier. The memory chips required are 4116 dynamic RAMs. (I ordered mine from Jade Computer Products and got excellent service and chips for the $85 cost.) Additionally, two 16-pin programmable shunts or DIP switches are needed. The DIP switches are preferred if you intend to install Level II BASIC at a later date.

Before you install the 16K memory, I should warn you that the Radio Shack warranty on your computer will be voided if you even open the computer-keyboard assembly. Since my 90-day warranty had already expired when I installed the 16K memories, I was not too concerned about this. You probably won't be either.

When you have the eight RAMs, two DIP switches and two screwdrivers in hand, you can begin the installation procedure, and in no more than 15 minutes, your computer will have 16K of memory. Just follow the steps outlined below.

1. Turn the computer-keyboard assembly upside down and remove the six screws with the Phillips screwdriver.

2. Turn the assembly right side up and remove the top cover from the keyboard.

3. Carefully lift the keyboard from its five supports and let it hinge toward you. While holding the keyboard in one hand, remove the five white plastic spacers, noting where they were inserted.

4. Then remove the entire PC (printed circuit) board assembly and keyboard from the bottom case and lay the PC board, component side up, on a table with the keyboard above it.

5. The 4K memory chips now need to be removed from the PC board. These chips are labeled Z-13 through Z-20 on the PC board. (Refer to Photo 1 for their exact location.) Before removing them, you should connect a wire jumper from your hand to ground to prevent static electricity from possibly damaging the chips as you touch them. You should also observe this technique for installing the new chips. To remove one of these chips, slip the flat blade of the screwdriver under one end of the chip and pry it up slightly. Then, pry the other end up slightly until the chip can be removed. Be careful as the pins can be bent easily. Remove the other seven chips in the same manner. Save these 4K chips as they can be used in the expansion interface that Radio Shack markets or can be used in a memory interface of your own design. Put them in the container the new chips were shipped in since it is conductive and will protect them.

6. Install the new 16K chips by inserting them into the now empty sockets. They need not be placed in any particular order. However, be careful to install the chips in the correct orientation. Either a small notch, dot or the numeral 1 should appear on the end of the chip, which should be placed toward the top of the board.

7. Remove the two DIP shunts labeled Z-3 and Z-71 using the removal technique described in step 5. The positions of these shunts are also shown in Photo 1. In this photo, the new DIP switches are shown installed. I used nine switch DIPs as I could not locate the eight switch DIPs needed. Examine Z-3 closely (in the top right of Photo 1) and you will find that I soldered the switches in backwards. Switch #1 should be closest to the edge connector, not switch #9. I managed to get Z-71 in correctly (one out of two is not bad). It is not necessary to remove the sockets and solder these switches to the board as I have done. They can simply be plugged into the empty sockets. As you plug your switches into the sockets at Z-3 and Z-71, check that switch #1 is toward the top of the board in both cases. Then, program the switches by referring to Fig. 1. Notice that Level I machines are programmed differently than Level II machines.

8. Reassemble your computer, plug in the power and turn the unit on. Type "PRINT MEM." If you have a Level I machine, the number 15,871 should be printed. If yours is a Level II machine, the number 15,572 should be printed. If the correct number is not displayed, recheck the programmable DIPs for mistakes and try again. If the number is still wrong, the problem could possibly be a bad memory chip.

Installation of Level II BASIC

The Level II BASIC kit must be ordered from Radio Shack. The kit contains a preassem-

DIP Pins	Switch Number	Level I 4K		Level I 16K		Level II 4K		Level II 16K		Level III 4K		Level III 16K	
		Z3	Z71	Z3	Z71	Z3	Z71	Z3	Z71	Z3	Z71	Z3	Z71
1,16	1	C*	O**	C	C	C	O	C	C	C	O	C	C
2,15	2	C	C	C	O	C	C	C	O	C	C	C	O
3,14	3	O	O	C	C	O	O	C	C	O	O	C	C
4,13	4	O	C	C	O	O	C	C	O	O	C	C	O
5,12	5	O	O	C	C	O	O	C	C	O	O	C	C
6,11	6	O	C	O	O	C	C	C	O	C	C	C	O
7,10	7	C	O	C	O	C	O	C	O	C	O	C	O
8,9	8	O	O	O	O	C	O	C	O	C	O	C	O

*C = Closed
**O = Open

Fig. 1. Look under the column heading corresponding to your machine to find the correct switch positions for Z3 and Z71.

bled printed circuit board, ribbon cable, resistor, two cassettes and a Level II manual. The cost of the kit includes installation by Radio Shack. They will take your computer-keyboard assembly and install the necessary parts. However, when the unit is returned to you, the ROM containing Level I BASIC will be missing, and in its place will be the Level II ROMs. (If you are not interested in having the Level III modification, let Radio Shack do the installation.) If you want Level III capability, *you* must install the Level II kit.

Before ordering the kit, check to make sure that you do not have one of the early model TRS-80s, as the Level III mod cannot be made on these models. This can be done by disassembling your computer as outlined in steps 1 through 4 of the 16K memory installation procedure. Then check the sockets labeled Z-33 and Z-34. If both of these sockets contain chips, you have an early model.

In these models, Level I BASIC is installed on two ROMs. If your unit contains two ROMs, the installation procedure described below will not apply. The majority of TRS-80s have only one ROM, either in socket Z-33 or Z-34. This ROM should be labeled BASIC I. The other socket will be empty.

Follow the installation procedure listed below for this type of ROM configuration. Some soldering and a few etch cuts are required to install Level II. You should have some experience with these techniques before attempting the conversion to Level II.

1. Remove the top cover of the computer-keyboard assembly. You are now ready to attach the 3-ROM printed circuit board provided in the Level II kit. Remove the protective covering from the adhesive backing on the small PC board. Firmly press this board into place beside the keyboard assembly. A properly positioned board is shown in Photo 2. The plastic tubing containing four colored wires should extend out to the left alongside the keyboard. The connection of these four wires will be discussed later.

2. The 24-pin ribbon cable extending down from the PC board should be routed around to the component side of the computer board. Remove the Level I BASIC ROM and plug the ribbon cable connector into its socket. Plug the Level I ROM into the remaining empty socket for the Level III option. Otherwise, leave the socket empty. Your board should now look as pictured in Photo 1.

3. Now we turn to the connection of the 4-wire cable. Three of the wires are to be connected to the computer address bus, and the fourth wire serves as an enable line for the ROMs. The connection of these wires is shown in Photo 3. Disregard the three wires in the right side of the photo, since they are not needed in the Level II installation but will be used later for Level III. The yellow wire should be connected to bit A_{11} on the address bus. This can be accomplished by soldering this wire to pin 13 of ICZ-38. The red wire should be connected to bit A_{12} on the address

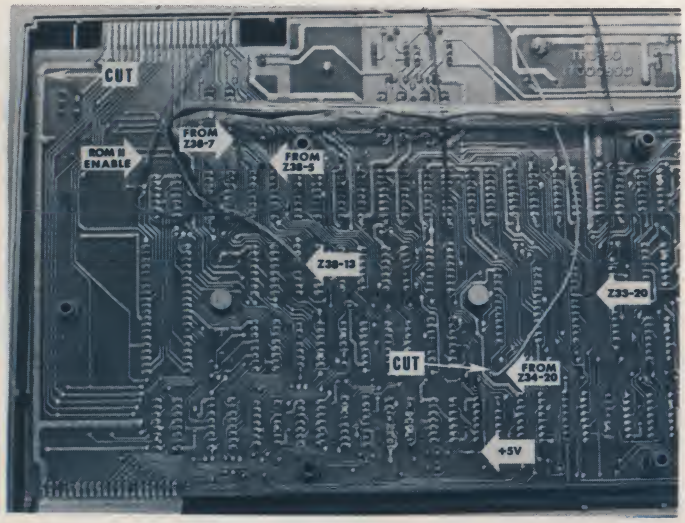


Photo 3. Backside (foil side) of the computer PC board. The connections for Level II BASIC and the modifications for Level III are pointed out.

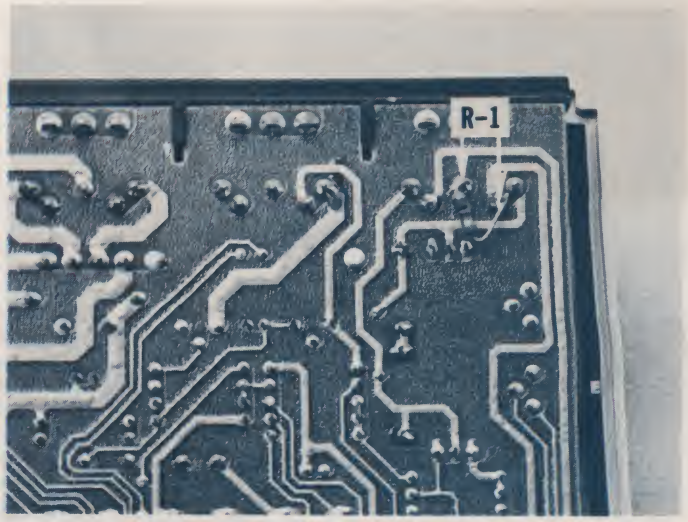


Photo 4. Computer and subassembly. This close-up shows the connection of the resistor supplied with the Level II kit which is labeled R-1. Its value is 4.7k Ohms.



Photo 5. Computer-keyboard case. The mounting of the Level I-Level II switch is shown.

bus by soldering this wire to pin 5 of ICZ-38 or by following the run from pin 5 of ICZ-38 up toward the edge connector. You will encounter a feedthrough in the board near this connector, and the wire can be attached at that point. The orange wire should be connected to bit A_{13} of the address bus. This connection can be made at pin 7 of the ICZ-38 or again at a feedthrough on the path leading from this pin to the edge connector. The green wire is the ROM enable line and can be left unconnected for now if you intend to have Level III capability. If you are installing only Level II, solder this wire to pin 6 of Z-3. Z-3 is one of the DIP switches and it will provide the enable pulse for the ROMs.

4. The resistor provided in the kit should now be connected. Its proper location can be seen in Photo 4. It is located in the top-right corner of the computer board. The purpose of the resistor, apparently, is to reduce the amplitude of the incoming cassette audio signal.

5. An etch cut should now be made on the board as a safety precaution. The location of the etch cut is shown in Photo 3 in the top-left corner. A jumper from pin 39 to pin 38 of the edge connector should be made. These modifications are not necessary, but keep more power from being drawn from the board through the edge connector. The power supply should not be loaded further. The +5 volt pin on this connector is changed to a ground by this modification.

6. If you are not concerned with the addition of Level I BASIC to your Level II machine, your installation job is almost complete. Program the DIP switches Z-3 and Z-71 as shown in Fig. 1. All that remains for you is to reassemble the case around your computer and plug in the power and video cables. When power is applied and the video monitor displays MEMORY SIZE, you are on your way with Level II BASIC. Enjoy the fruits of your labor.

Modifications for Level III BASIC

Before continuing, check to make sure that your Level I ROM is plugged into socket Z-34 and that socket Z-33 contains the ribbon cable connector that leads to the Level II ROM board. Also, the green wire, which is the enable line for the Level II ROM board, should not have been connected yet.

A double-pole, double-throw switch will be needed to make the modifications suggested. Fig. 2 illustrates the connection of the switch to a TRS-80 as outlined in the steps below. Number 26 insulated wire is recommended for the jumpers, which should be approximately 12 inches long to allow for proper positioning of the switch.

1. Contacts 2 and 5 of the switch are the swingers. Pin 2 should be connected by means of a 12-inch jumper to the green wire of the Level II ROM board. As such, this contact serves as

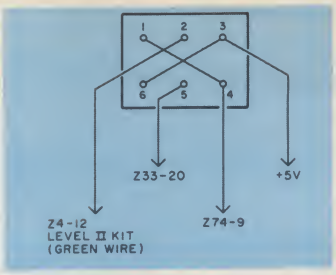


Fig. 2. Switch connections for LEVEL III option.

the enable for the Level II ROMs. Contact 5 should be connected to the backside of the computer board at pin 20 of either Z-33 or Z-34. This contact serves as the enable for the Level I ROM.

2. Contacts 3 and 6 of the switch should be jumpered together with a short piece of wire. Then a jumper from these contacts to a source of +5 volts on the computer board should be made. I made the +5 volt connection at pin 16 of Z-69. The jumper is actually soldered to a feeder that runs from this pin toward the bottom of the board. This serves to hold the enable line of the unused ROM in the inactive high state, as the enable lines are active low.

3. The two remaining contacts, 1 and 4, should also be jumpered together. Then, a jumper from these pins to the backside of the PC board should be made. The connection point is at a feedthrough located below pin 20 of Z-34. The exact location is illustrated in Photo 3. This is the chip enable sent from the Z-80 microprocessor to the BASIC ROMs.

4. Now make an etch cut just above the feedthrough pinpointed in step 3. If this etch cut is not made, the Level I ROM will never be disabled.

5. Program the DIP switches Z-3 and Z-71 as shown in Fig. 1 for Level III.

6. The only remaining task is to mount the switch in the case of the computer. I found the position shown in Photo 5 to be very favorable. There is enough room in this area of the case to prevent the switch contacts from touching any part of the PC board. The job is complete when you have finished mounting the switch.

With the modifications described in the previous steps, Level I BASIC will be enabled with the switch in one position, and Level II BASIC will be functional with the other position of the switch. Don't try to switch from Level I to Level II or vice versa while power is applied because errors will occur. I hope you enjoy your Level III TRS-80 as much as I have enjoyed mine.

Conclusion

In conclusion, I would like to add a few tips on the use of a cassette recorder with Level II BASIC. The volume setting of



Photo 6. The Level II kit as supplied from Radio Shack. Also shown is the double-pole, double-throw switch for Level III.

the recorder is much more critical than it was when using Level I BASIC due to the higher baud rate. You can easily waste an hour getting a cassette to load in properly if the volume is not adjusted properly. This is especially true if you are using a recorder other than the one supplied by Radio Shack.

I have found it helpful to place a radio near the computer-keyboard assembly while loading cassette tapes. Tune the dial in between stations (preferably using the AM band) and start the cassette in motion with the CLOAD command. Turn the volume control slowly from low to high. You will notice a high-frequency pulsing sound become progessively clearer and then fade out as the volume is increased. Adjust the volume dial for maximum clarity of this sound and then reset your computer. The cassette recorder should now be close to the correct volume setting.

You can also use the radio for unique sound effects. Write a short BASIC program with several different timing loops incorporated using FOR-NEXT statements. As the program is executed the radio will pick up various frequency signals generated on the computer board. For different sounds, change the length of the timing loops or tune the radio to a different frequency. ■



Photo 7. The author's TRS-80 system.

Acknowledgement

I would like to thank Jack McCraw for the photography and artwork appearing in this article. Also, I would like to thank Fran Gange for typing the manuscript.



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Probos V

Even in these inflationary times a logic probe for the cost of a fast-food lunch isn't bad!

Steve Dominguez
29 Mines Park
Colorado School of Mines
Golden CO 80401

Logic probes have been around for a long time. Few test instruments are as convenient or easy to use for troubleshooting digital circuits as the logic probe. With it, you can quickly determine if your circuit is functioning properly and rapidly isolate any problems that occur.

Unfortunately, most commercial probes cost more than many of us can afford. When I first became involved in digital electronics, I did all of my troubleshooting with an LED. But I soon learned this wasn't the best way to search out logic gremlins. And besides, I was running out of LEDs; my evil side, Dr. Diode, gets his kicks plugging 'em into the wall sockets and watching them blow up!

Since I couldn't afford a commercial logic probe, I set out to build one from scratch. Every probe I had built from plans I "ripped-off" the library had some sort of fault. Either they didn't work right, didn't do what I wanted or else used some weirdo part that was impossible to find. Finally, I remembered what my father said to me every time I loused up a job he gave me: "The only way to get something done right is to do it yourself!" Thus, I designed Probos V.

By now you're probably grumbling to yourself, "Oh, no, another one of those 'Build a Simple Logic Probe' articles." Not so. If there is one thing I'm fed up with, it's a simple logic probe.

My logic probe had to do at least five things:

1. Indicate logic 0 states
2. Indicate logic 1 states
3. Indicate Tri-state outputs
4. Detect both positive and negative pulse transitions
5. Work with TTL and TTL-compatible circuits

I have yet to see a circuit that meets all five of these requirements.

Probos V does all that I want and then some. It performs as well as many commercial probes and doesn't cost more than two hamburgers, french fries and a shake! You should be able to build Probos V for under $5.00; I built mine for $1.40!

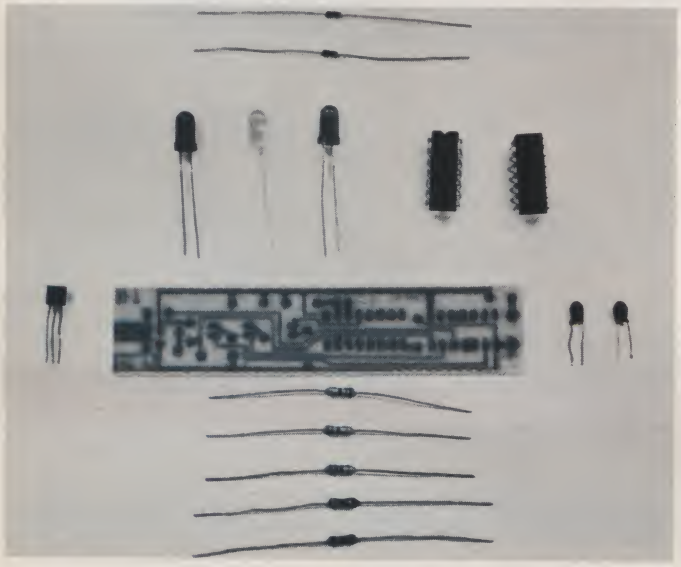
Circuit Theory

The simplest of all logic probes consists of merely an LED connected between +5 volts and a test point as shown in Fig. 1a. Unfortunately, most TTL circuits don't like this kind of Rube Goldberg setup. Most TTL circuits consider a logic 0 as any voltage below 0.8 volts and a logic 1 as any voltage above 2.4 volts. Generally speaking, TTL gates can sink up to 20 mA in their logic 0 states. This means the gate can supply up to 20 mA of current without causing its output voltage to rise above 0.8 volts.

The same is essentially true for gates in their logic 1 states. If we tried to pull more than 20 mA from them, their output voltage would drop to about 1.7 volts, which is neither a logic 1 nor 0. As a result, we would disable any gates connected to the output since the output voltage isn't high enough to be distinguished as a logic 1.

Since most LEDs require about 20 mA, connecting them directly to the output of a gate in the test circuit can upset even the parts of the circuit that are working. While the LED will probably light up, the gate's output voltage will enter a state of limbo between 0.8 and 2.4 volts; consequently, any gate connected to this output is disabled, and the circuit malfunctions. That's bad—we certainly don't want a test instrument that does that.

So what do we do? We can put a current-limiting resistor in series with the LED to cut its current down to about 15 mA. But this doesn't solve anything



Components needed for making Probos V. The PC board is optional.

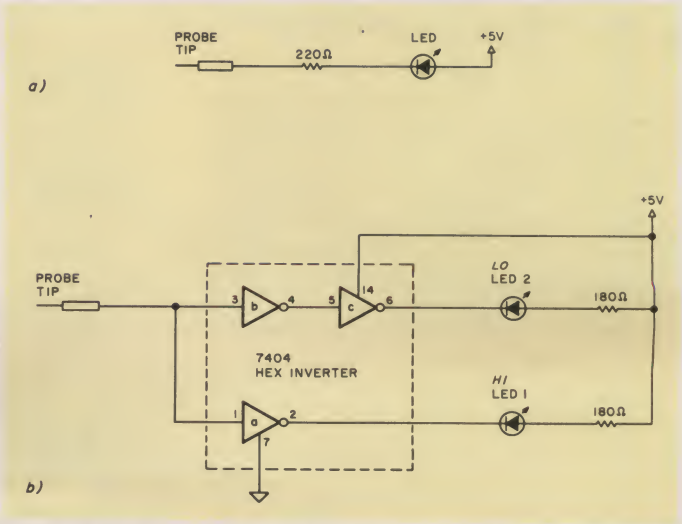


Fig. 1. Bare, minimum logic probe (a); improved second-generation logic probe (b).

if we are testing a gate that is already sinking 12 mA, for example. 15 mA + 12 mA = 27 mA, 7 mA over the limit and bound to create some problem. If we further reduced the LED's current, we wouldn't be able to see it (now, what good is that?).

In addition to loading down the test circuit, the LED logic probe has two other problems. First, it can detect only one logic state and cannot distinguish open circuits. Second, it cannot detect pulses or pulse trains over 25 Hz.

As you can see, an all-LED logic probe is not a good idea. However, we must still use the LEDs to show the logic levels without loading down the test circuit. The solution is simple: We can put a few inverters on *our logic probe* to drive the LEDs. Fig. 1b shows the schematic for the second-generation logic probe.

Inverter A turns LED 1 on when the probe tip touches a logic 1 test point. This is because the LED lights only when its cathode is connected to a logic 0 output. The inverter inverts the 1 into a 0, and the LED lights up.

Inverters B and C invert twice, so LED 2 lights when the probe tip touches a logic 0. Since inverters A and B require only 2 mA of input current each (4 mA total), we can safely probe our faulty circuits without fear of loading them down. The inverters themselves supply the 20 mA needed for each LED. In effect, the inverters do two things: (1) drive the LEDs and (2) distinguish between high and low logic states.

While the second-generation probe is significantly better than the LED probe, it still has a few problems. The circuit still cannot tell the difference between logic 1 and floating inputs. That is, LED 1 will light if the probe tip contacts a logic 1 output or if it touches a disconnected output. While this is normal for TTL logic, it certainly is not *desirable for a test instrument*. And like the first LED logic probe, our second-generation model cannot detect pulses.

Probos V completely eliminates these two problems. The complete schematic for Probos V is shown in Fig. 2. As you can see, it is an overhauled version of our second-generation probe. R1, R2 and Q1 have been added to force a logic 0 into inverter A when the probe tip touches an open circuit. Now the HI LED (L2) turns on only when the probe tip touches a logic 1 output. Otherwise, it remains dark, as does the LO LED (L1). Now our logic probe can distinguish between high, low, floating and Tri-state (which is essentially the same as a floating output) outputs.



Probos V completely assembled.

But our problem is still not solved. We now need a way of detecting pulses. Fortunately for us, there is an IC that will do this. It is called a monostable multivibrator, or, simply, a one-shot. The one-shot is a special-purpose flip-flop with a resistor and a capacitor connected to it. When the one-shot detects a pulse on its clock input, its output changes from $\overline{Q}$ to Q. Simultaneously, the capacitor is charged. Regardless of how long the pulse stays in its logic 0 or 1 state, the capacitor immediately begins to discharge via the resistor. Once it has discharged, the one-shot's outputs change from Q back to $\overline{Q}$. By varying the RC time constant of the resistor and capacitor ($T = R \times C$), we can change the amount of time the Q output is on. Probos V has a time constant of about .3 seconds (0.3 sec = 15k × 22uF).

I used the 74122 one-shot for the simple reason that I didn't have any others I could use. The 74122 is triggered by apply-

C1—22 uF, 16 volt tantalum capacitor
C2—4.7 uF, 16 volt tantalum capacitor
D1,D2—1N4148 (or 1N914) signal diode
L1-L3—Light emitting diode (see text)
IC1—SN74122N monostable multivibrator
IC2—SN7404N hex inverter
Q1—2N2222 NPN transistor
All resistors 1/4W, 5%:
R1—2k
R2—390 Ohm
R3,R4,R6—180 Ohm
R5—15k
Misc.: Printed circuit board, probe tip, hookup wire, alligator clips, IC sockets, solder, etc.

Parts list.

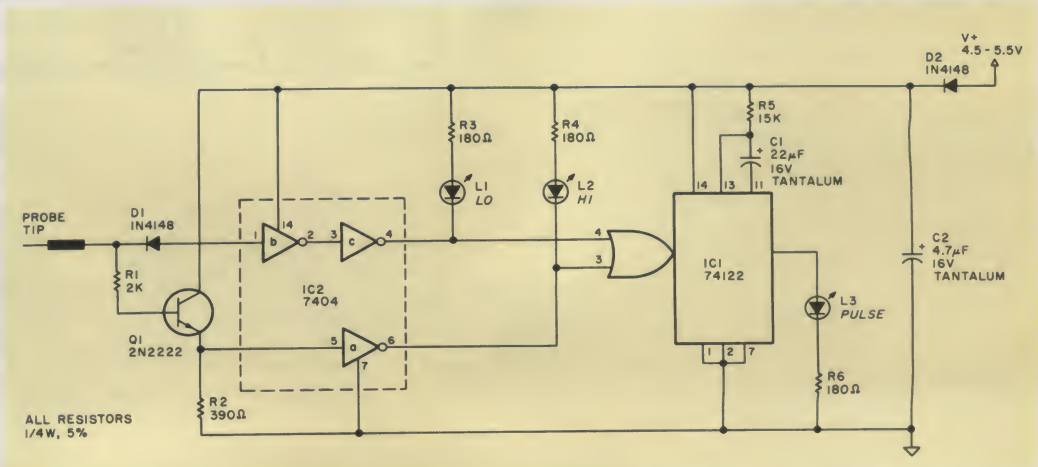


Fig. 2. Complete schematic for Probos V.



Probos V in action troubleshooting another one of the author's bum circuits! Note that the logic probe is powered by the circuit being tested.

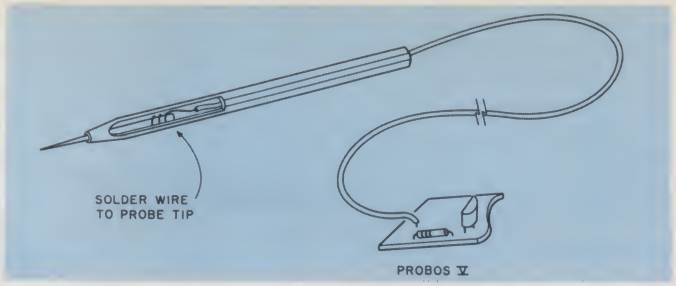


Fig. 5. Probe tip can be installed inside a pen case and wired to Probos V as shown.

ing a logic 0 on its clock input. Hence, it would detect only negative (HI to LO) pulse transitions. No good! I wanted a logic probe that would indicate positive (LO to HI) as well as negative pulse transitions. Fortunately, the inverter section of Probos V lends itself quite nicely to solving this problem.

As you will recall, the HI and LO LEDs light only when their cathodes are at a logic low. The two LEDs, however, indicate different logic states. By ORing the one-shot's clock input with the outputs of inverters A and C we get a logic 0 pulse on the clock whenever the probe tip contacts a high or low logic level.

At last the problem is solved. Since the 74122 has an OR gate built right into it, we don't need to add another IC. By connecting an LED to the one-shot's Q output, we have a way of indicating the presence of a pulse. If a pulse only 100 nanoseconds wide whisked by the probe tip, we would never notice it if we observed only the HI and LO LEDs. They would change states too fast to notice. But the one-shot catches the pulse and turns on the PULSE LED (L3) for 0.3 seconds, indicating the presence of a pulse.

We now have a logic probe that can differentiate between logic levels, open circuits and pulses of both the positive and negative variety. It doesn't require many parts or cost a sultan's fortune. What more could you ask for?

Construction

Probos V can be constructed in any manner you choose. Since I wasn't concerned about cramming everything inside a ball-point pen (after all, the commercial probes aren't), I built mine on a printed circuit board. The etching and drilling guide for the PC board is in Fig. 3.

Once you have made the PC board, solder in the resistors. The parts placement guide in Fig. 4 shows where the parts are to be mounted. Next, solder in the diodes (watch polarity!) and the jumper wire. Now install the transistor and the ICs, paying particular attention to their orientation. Then solder in the two capacitors, once again being careful of polarity. I specified tantalum capacitors in the schematic and parts list only because they are much more compact. If you wish to economize, you can use less costly electrolytic capacitors without sacrificing circuit performance.

Next install the LEDs. Be sure they stick up above everything else if you plan to mount Probos V in a case. I'm quite fond of pretty lights so I used a different-color LED for each logic state. You may want to do the same.

Once you have all the parts mounted on the PC board, attach a probe tip and the power leads. For the probe tip, I used an ordinary straight pin. The sharp point is good for piercing solder masks as well as yourself, so you may prefer to use a less pointed probe tip, such as a small finishing nail. You might also want to mount the probe tip in a pen by itself and connect it to Probos V via a piece of wire as depicted in Fig. 5.

The power leads are easier to connect to a power supply if you attach alligator or, better yet, IC test clips to the ends of them. Color coding the wires (red for Vcc, black for GND) helps prevent hooking them up backwards.

Checkout

Probos V is powered by the circuit under test. Connect the Vcc lead to the +5 volt terminal and the ground lead to the ground terminal of a dc power supply. When the power is turned on, the PULSE LED will light momentarily. The other two LEDs should remain dark.

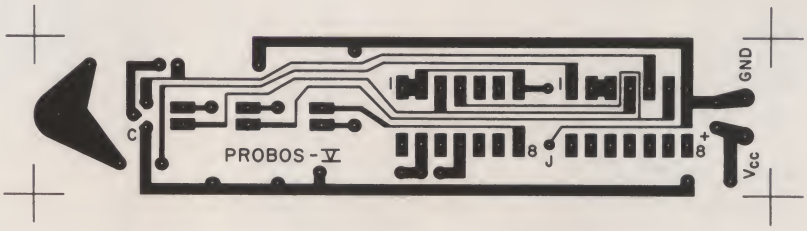


Fig. 3. Full-size etching and drilling guide for printed circuit board.

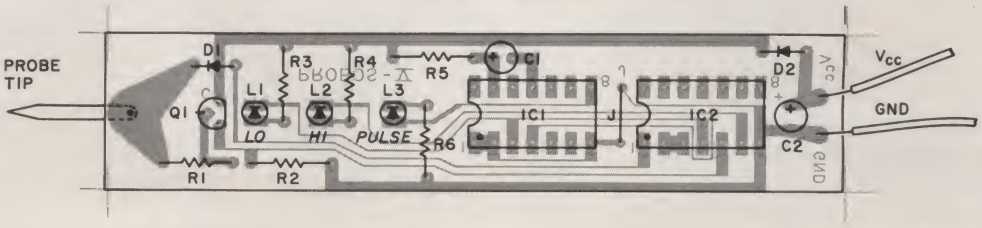


Fig. 4. Parts placement guide for Probos V's PC board. Watch orientation of capacitors and semiconductors.

HI LED	LO LED	PULSE LED	Condition Indicated
OFF	OFF	OFF	Insufficient or no Vcc, no contact, floating or high impedance (Tri-state) input.
ON	OFF	OFF	Logic 1 state.
OFF	ON	OFF	Logic 0 state.
ON	OFF	ON	Positive pulse transition.
ON	OFF*	ON	Narrow negative pulse or pulse train.
OFF	ON	ON	Negative pulse transition.
OFF*	ON	ON	Narrow positive pulse or pulse train.
ON	ON	ON	Pulse train with fairly even duty-cycle. At low frequencies LEDs will blink on and off; at higher frequencies, they will appear to be continually lit.
OFF	OFF	ON**	Fluctuating or unstable Vcc.

*Weak or dim LED
**Blinking LED

Table 1. Conditions that can be indicated by Probos V.

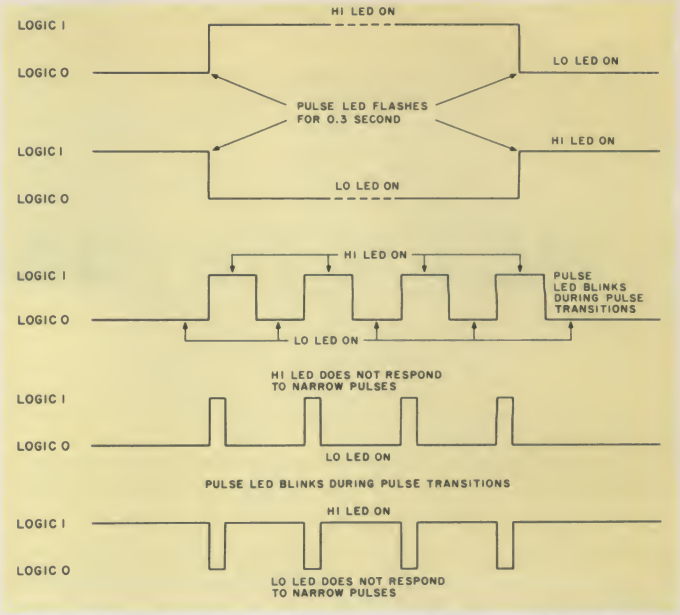


Fig. 6. Various waveforms and indications detectable with Probos V.

Touch the probe tip to ground. The PULSE LED should blink, and the LO LED should now be lit.

Now touch the probe tip to +5 volts and observe that the PULSE LED will blink again. The HI LED should now be lit (the LO LED should have turned off as soon as you removed the probe tip from ground). If the probe appears to be malfunctioning, check to see that it is properly hooked up to a working, filtered, 5 volt dc power supply. If it is, kill the power and check the probe for missing parts, cold solder joints, broken or shorted wires (or PC board foil traces), defective components and improperly installed parts.

Usage

If everything goes as it is supposed to, Probos V will be complete. If you are industrious, you may want to put it inside a case. I didn't bother to build a case.

Table 1 and Fig. 6 show the various conditions Probos V can indicate. As you can see, Probos V can detect many conditions in the test circuit.

To use Probos V, simply connect the Vcc and ground leads to the Vcc and ground in the circuit you are testing. Touch the probe tip to any point in the circuit to see what's happening there.

A few words of caution: Do not use Probos V to troubleshoot circuits whose Vcc is greater than 5 volts. Also, I don't recommend using Probos V on MOS or CMOS circuits that are not TTL compatible or have been buffered with a 4049 IC, for example.

As a final note, you may wish to build Probos V with a dual one-shot IC such as the 74123. The second one-shot could be used as a pulse injector that is triggered by a push-button switch. You could also use a 555 timer as a pulse train (signal) injector. This would make it easier to test flip-flops, counters, etc., since you could inject a pulse into them to advance them into a new state.

Since Probos V is inexpensive to build, you could build several of them for a super data bus or IC monitor. Just be careful you don't add so many that power requirements become a problem. Each logic probe requires about 40 mA.

Conclusion

Probos V is an amazingly versatile instrument capable of checking out the operation of TTL, RTL, DTL and some CMOS circuits. And Probos V is extremely cost effective, performing as well, if not better, than commercial probes costing ten times as much. Is this the ultimate logic probe? I hope not! ■

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PET's Keyboard Grows Up

Owners of older PETs have suffered with their Munchkin-size keyboards long enough.

Robert W. Baker
15 Windsor Drive
Atco NJ 08004

Since Commodore first introduced the PET, everyone has complained about the small keyboard. Some owners have added their own full-size keyboard, while others "just made do" or simply bought another computer system altogether. After using my PET for about a year, I finally decided I really liked the system, but I had put up with the small keyboard long enough, and it was time to do something about it. The painted metal keytop inserts were starting to show signs of wear, and the larger RETURN and SPACE keys did not always register, depending on where they were pressed.

While looking over the small number of replacement keyboards and ASCII keyboard interfaces available for the PET, I came across a new unit being manufactured by Maxi Switch for Century Research & Marketing of Minneapolis. Once I received more information about their design and found the price was $109.95, I simply had to try one on my system as soon as possible.

Keyboard Features

This is the first replacement keyboard with PET graphic characters actually molded into the keytops. The key layout is almost identical to the original PET design with several small changes and improvements (as can be seen in the photograph):

1. The SHIFT keys on both sides have been moved up a row to their normal positions, one row above the space bar.
2. The OFF RVS key has been moved up two rows, where a typewriter SHIFT LOCK key would normally be found.
3. With the SHIFT and OFF RVS keys moved up, a standard, full-size space bar was used.
4. An extra row of keys was added on the right side of the numeric pad to provide additional SHIFT, RETURN, SPACE and ? keys, which facilitate program *debugging*, *editing*, *numeric* calculations while in immediate mode, etc.
5. A blank, unused switch that may be wired however desired was added on the top row. This switch can easily be used to add a system reset key to the PET, and there is even a way to add an electrical interlock for a reset key to provide safety against accidental resets.

Mechanically, the keyboard appears to be rugged, even though an enclosure was not available when I received my unit. All the switches are mounted on a metal plate with a single printed circuit board providing all the switch interconnections. The keytops are two-shot, molded plastic with white lettering and graphic characters, so there shouldn't be any problem with wear. All the function, cursor control and editing keys are blue, while the majority of the keytops are gray.

Connection to the PET is through a single ribbon cable



Maxi Switch's full-size replacement keyboard for the PET.

that replaces the cable from the PET keyboard. Since the keyboard is a simple, direct switch matrix, there are no fancy interface boards with ROM decoders, and there is no logic hardware involved. I have not had one problem with bounce, double characters, missing key hits, etc., in the four weeks I've been using my new keyboard.

Connections

To attach the new keyboard, simply unplug the old keyboard and plug in the cable from the new keyboard. The connector from the new unit is currently not a stacking-type connector, so the PET keyboard must be completely disconnected. Some replacement keyboards do provide the ability to use both keyboards simultaneously, but the *graphic characters are* not indicated, and several special functions may not be available on their keyboards (or may only be available through specific combinations of keys).

Once you've connected the Maxi Switch keyboard, you'll forget all about using the original keyboard. I've even been thinking of removing the old keyboard from my PET and mounting a panel for switches, displays, a speaker, etc.

To use the available blank switch as a system reset switch, connect the switch between pins A27 ($\overline{\text{RES}}$) and B27 (GND) on the memory expansion connector. Whenever you press the new reset switch, the screen will flicker for a few seconds while the system is reinitialized, then the normal messages displayed at power-on will reappear. If you're worried about accidentally pressing the reset switch while typing on the keyboard and losing your entire program, fear not, for there is a solution.

Each of the RETURN keys on the new keyboard has a double-width keytop, and there are two switches under each. Both switches are used under the normal RETURN key, but only one is used on the new key added to the numeric pad. To provide an electrical interlock for the reset switch, just wire the unused switch under the extra RETURN key in series with the blank switch. Now, you must press both switches simultaneously to generate a system reset. Pressing the extra RETURN key alone still produces a RETURN function, while pressing the reset switch (the blank switch) alone will have no effect.

Conclusion

Having already used the PET keyboard arrangement for some time, I quickly became familiar with the slightly new format. Key positioning is still not identical to a typewriter, but the only major difference is having to use the numeric pad instead of the top row of keys for numbers. Also, the semicolon and colon are still on separate keys, and the period is only present in the numeric pad. These differences have not proven to be of any disadvantage for me personally, but this would be a matter of personal preference.

The "feel" of the keyboard switches is comfortable, similar to using a Selectric typewriter. The difference in size and the "feel" of the keys is significant for me after using the original Commodore keyboard for so long. How did I ever put up with that "toy" keyboard for so long? Even Commodore is now offering a full-size keyboard in the newer PET models, but, after seeing the original keyboard, I wonder how good they'll really be.

Cost of the new keyboard is only $109.95 plus $5 shipping, but this does not include an enclosure for the keyboard, which is available for an additional $25.

For anyone interested in ordering a keyboard for his system or sending for more information, he cannot deal directly with Maxi Switch. All correspondence should be addressed to: Century Research & Marketing, 4815 W. 77th Street, Minneapolis MN 55435. In Europe, you can contact the following for pricing/availability: Erhargt & Jost Electronic, Rossligasse 2, CH-4450 Sissach, Switzerland.■

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Hurricane!

Hurricane season isn't over. If you are unfortunate enough to live in a hurricane-prone area, here's a program that will enable you to monitor the next big storm that blows your way.

Bryce Segar
130 H. L. Sudduth Drive
Panama City FL 32401

Whether you live in an area vulnerable to hurricanes or not, it is interesting, and many times vital, to be able to monitor the hurricanes that occur each year. Using the program in this article, you can monitor a hurricane's status in comparison to your location or any location you choose. In addition, while it is impossible to consistently predict the path of a raging hurricane with any degree of accuracy, it is possible, using your computer, to accurately track the hurricane and make straight-line path predictions.

What the Program Does

The program is written in Level II 16K BASIC for the TRS-80 computer. It will provide you with an accurate monitoring capability. Using the latitude and longitude of your location as its base and inputting the latitude and longitude along with the speed and direction of the hurricane being tracked (normally available through the National Weather Service), the program will determine the hurricane's precise degree of angle (in degrees from true North), as compared to your location. In addition, it will compute the distance in miles between your location and the hurricane.

The program will also tell you whether the hurricane is currently headed in your direction. If the hurricane is traveling in a straight line toward your location, the program will output a hurricane warning and a hurricane condition status number (using the hurricane categories established by the National Weather Service). It will also predict the number of hours before the storm hits your area.

How the Program Works

Program lines 6 through 82 initialize the Hurricane program and provide the input statements that set up the variables. When entering the degrees of latitude and longitude, do not enter the minutes or seconds. You must first convert them to decimals by dividing them each by 60 and then adding them on to the whole degree number.

The critical element of the

Program listing.

```
1 REM  * * *  HURRICANE LOCATION AND DISTANCE CALCULATOR  * * *
2 REM         WRITTEN BY BRYCE D. SEGAR
3 REM         PROGRAM RUNS IN TRS-80  LEVEL II  -  16K!
4 REM         SEE TEXT TO RUN HURRICANE PROGRAM IN  - 4K!
5 REM  <<<<<<<<  INITIALIZE PROGRAM
6 CLEAR100:CLS:PRINT@384,"";:GOSUB6000:FORTT=1TO2000:NEXT
7 CLS:PRINT:GOSUB6000:PRINT:INPUT"ENTER NAME OF YOUR LOCATION";II$
8 PRINT:INPUT"ENTER YOUR LATITUDE IN DEGREES";A:PRINT:INPUT"ENTER YOUR LONGITUDE IN DEGREES";G
10 CLS:PRINT:GOSUB6000:PRINT
35 INPUT"WHAT IS THE NAME OF THE HURRICANE";A$:PRINT
45 PRINT"INPUT LATITUDE OF HURRICANE ";A$;" IN DEGREES";:INPUTB:PRINT
70 PRINT"INPUT LONGITUDE OF HURRICANE ";A$;" IN DEGREES";:INPUTH
80 PRINT:PRINT"WHAT IS ";A$;"'S CURRENT DIRECTION OF TRAVEL (IN DEGREES)";:INPUTDD
82 PRINT:PRINT"WHAT IS ";A$;"'S CURRENT SPEED (MPH)";:INPUTSS
90 REM  <<<<<<<<  CALCULATE LOCATIONS AND DISTANCE
98 CLS:IFA=B AND G=H THEN H=H+.1
100 PRINT:GOSUB6000:I=G-H:L=I
110 IF(I<180)AND(I>-180)GOTO200
120 J=I+360:L=J
130 IF(J<180)AND(J>-180)GOTO200
140 L=I-360
200 IFL>0R=1
201 IFL<0R=0
204 E=SIN(A*.0174533):F=SIN(B*.0174533):K=COS(A*.0174533)
230 M=COS(B*.0174533):N=COS(L*.0174533):D=(E*F)+(K*M*N)
310 O=(-ATN(D/SQR(-D*D+1))+1.5708)*57.29578
320 P=SIN(O*.0174533):Q=(F-(E*D))/(K*P)
350 C=INT((-ATN(Q/SQR(-Q*Q+1))+1.5708)*57.29578)
360 IFR=0C=360-C
400 QQ=(E-(F*D))/(M*P)
410 CC=INT((-ATN(QQ/SQR(-QQ*QQ+1))+1.5708)*57.29578)
435 IFR=1CC=360-CC
470  D=O*60*1.15078:D=INT(D+.5):PRINT
480 REM  <<<<<<<<  DETERMINE DIRECTION
550 IFC>=0ANDC<15THENG$="NORTH":GOTO600
558 IFC>=15ANDC<75THENG$="NORTHEAST":GOTO600
560 IFC>=75ANDC<105THENG$="EAST":GOTO600
563 IFC>=105ANDC<165THENG$="SOUTHEAST":GOTO600
565 IFC>=165ANDC<195THENG$="SOUTH":GOTO600
568 IFC>=195ANDC<255THENG$="SOUTHWEST":GOTO600
570 IFC>=255ANDC<285THENG$="WEST":GOTO600
573 IFC>=285ANDC<345THENG$="NORTHWEST":GOTO600
575 G$="NORTH"
600 GOSUB1000:GOSUB5000
602 REM  <<<<<<<<  PRINT "NO ALARM" TEXT
605 PRINT"HURRICANE ";A$;" IS CURRENTLY ";D;" MILES ";G$;" OF"
610 PRINTII$;".   BEARING FROM ";II$
615 PRINT"IS ";C;"  DEGREES FROM TRUE NORTH."
650 GOSUB5000
700 PRINT"IF HURRICANE ";A$;" MAINTAINS HER CURRENT SPEED OF ";SS;"
705 PRINT"MILES PER HOUR AND DIRECTION OF ";DD;" DEGREES FROM TRUE NORTH"
710 PRINT"THERE IS NO CAUSE FOR ALARM.  PLEASE CONTINUE TO MONITOR"
720 PRINT"HURRICANE ";A$;" CLOSELY."
750 GOSUB5000
800 PRINT:FORTT=1TO1000:NEXT:PRINT"PRESS ENTER TO INPUT NEW STATUS ON HURRICANE ";A$;:INPUTUU$
810 CLS:PRINT:GOSUB6000:PRINT:GOTO45
900 REM  <<<<<<<<  DETERMINE IF PATH IS IN YOUR DIRECTION
1000 KK=10:IFD<200THENKK=20
1001 IFD<400THENKK=15
1002 IFD<90THEN9000
1005 P$=II$
1050 IFDD<(CC+KK)ANDDD>(CC-KK)THEN2000
1060 IFDD<KKANDCC>360-(KK-DD)THEN2000
1065 IFDD>(360-KK)ANDCC<KK-(360-DD)THEN2000
1070 IFD<100THEN2000
1090 RETURN
```

Hurricane program is built around some mathematical wizardry aptly called spherical trigonometry. Lines 98 to 470 perform the majority of the computations. Two basic trigonometry equations are used to calculate the angles and distances; the rest are conversions in and out of the trig functions. The trigonometric functions of the TRS-80 use radians in their calculations, which must be converted to and from degrees. This accounts for some of those long, magic-looking numbers mixed among the sines and cosines in the program.

Lines 550 through 575 use the calculated bearing from your location to produce a verbal direction (i.e., northwest, southeast) towards the hurricane. Lines 1000 through 1070 determine if the hurricane is headed in your direction. If the hurricane is more than 400 miles from you, the program will take the current direction that the storm is heading, will compare it with the computed direction from the storm to your location and, if that direction is within 10 degrees of either side of the straight line between the storm and you, will output the hurricane warning. If the hurricane is between 200 and 400 miles from you, 15 degrees of variance will be used. If it is between 90 and 200 miles from you, then 20 degrees will be used.

Increasing the angle of variance compensates for the fact that the closer the storm gets to you, the less accurate the prediction needs to be or, in other words, the more the chance that the storm will hit your area.

Hurricane Conditions

Five hurricane conditions, called HURCONS, were developed by the National Weather Service to advise of a hurricane threat. The HURCON number is designed to be determined by the amount of time it will take the hurricane to travel from its current location to your location and by the movement velocity (minimum 50 knots) of the storm center. The HURCON numbers in Hurricane are strictly determined by the time factor and do not take into consideration the surface wind requirement. Lines 2500 to 2640 calculate the amount of time it will take the hurricane to get to your location and then select the correct HURCON number.

One final note: HURCONS should not be confused with the National Weather Service Category of Storm. HURCONS do not advise on the intensity of the storm, only the hurricane threat.

The rest of the Hurricane program lines are either used for variable explanation (video text) or are informational, as in the complete listing of Hurricane conditions.

4K Modification

If your TRS-80 does not have 16K of memory, then see Fig. 1 for the lines to delete and the two short modifications that will allow the program to run in 4K of memory. These modifications only take away some of the niceties of Hurricane; the program still retains all the computational power of the 16K version.

You can also save memory and personalize the program by entering your location as string variable II$ in line 7 and your latitude as variable "A" and longitude as variable "G" in line 8. Make sure you delete the appropriate statements in lines 6, 7, 8 and 10 when you enter these variables as part of the program.

Checkout

One of the nicest things about entering programs out of your favorite computer magazine into your microcomputer is that you don't have to always understand the technical side (i.e., equations, algorithms, etc.) of what you are programming into the microcomputer. With many programs, if you make a small mistake, the computer (especially the TRS-80) will let you know and, if all goes well, it will only take a few moments to correct.

With the Hurricane program, as with any computer program that uses complex equations, one or more small mistakes in any of the mathematical functions could go undetected. So, be extra careful when you enter those magic numbers and equations. Just in case you

```
1095 REM  <<<<<<<<  PRINT INITIAL WARNING
2000 CLS
2010 FORXX=1TO4
2020 PRINTCHR$(23)
2030 PRINT@380,"   * *  H U R R I C A N E  * * "
2040 PRINT@574,"    * * *  A L E R T  * * *"
2050 FORTT=1TO250:NEXTTT:CLS:FORTT=1TO10:NEXTTT
2060 NEXTXX
2400 REM  <<<<<<<<  COMPUTE TIME TILL IMPACT
2500 TIME=D/SS
2520 TS=FIX(TIME):TB=TIME-TS:TC=FIX(TB*60)
2600 II=5
2605 REM  <<<<<<<<  DETERMINE HURCON NUMBER
2610 IFTS<72THENII=4
2620 IFTS<48THENII=3
2630 IFTS<24THENII=2
2640 IFTS<12THENII=1
2900 REM  <<<<<<<<  PRINT HURCON WARNING TEXT
3000 GOSUB6000:PRINT:PRINT"   * * *  H U R C O N  ";II;"  N O W   I N  E F F E C T  * * *":GOSUB5000
3010 PRINT"HURRICANE ";A$;" IS CURRENTLY ";D;" MILES ";G$;" OF ";II$
3015 PRINT"BEARING FROM ";II$;": ";C;" DEGREES FROM TRUE NORTH."
3018 GOSUB5000
3020 PRINT"IF THIS HURRICANE MAINTAINS ITS CURRENT SPEED OF ";SS;" MILES"
3030 PRINT"PER HOUR AND CURRENT DIRECTION OF ";DD;" DEGREES, THE CENTER"
3035 PRINT"OF THE STORM CAN BE EXPECTED TO HIT THE ";II$
3040 PRINT"AREA IN APPROXIMATELY ";TS;" HOURS."
3100 GOSUB5000
3200 PRINT@902,"PRESS LETTER - H - TO INPUT NEW STATUS ON HURRICANE"
3210 PRINT"    PRESS LETTER - C - TO REVIEW HURRICANE CONDITION NUMBERS";
3300 PRINT@771,"    * * *   H U R R I C A N E    W A R N I N G    * * *"
3310 FORTT=1TO200:NEXTTT
                                                                      "
3315 PRINT@768,"
3317 FORTT=1TO20:NEXTTT
3320 MM$=INKEY$:IFMM$="H"THENCLS:PRINT:GOSUB6000:PRINT:GOTO45
3325 IFMM$="C"THENCLS:PRINT:GOTO8000
3350 GOTO3300
5000 PRINTSTRING$(63,"*"):RETURN
6000 PRINT"   * * *  HURRICANE LOCATION AND DISTANCE CALCULATOR  * * *"
6001  RETURN
7000 REM  <<<<<<<<  HURCON LISTING
8000 PRINT"          H U R R I C A N E   C O N D I T I O N S":PRINT
8010 PRINT"     A.  H U R C O N  5 :  A HURRICANE READINESS STATUS"
8020 PRINT"     CONSISTENT WITH SOUND PRECAUTIONARY MEASURES EFFECTIVE"
8030 PRINT"     1 JUNE THROUGH 30 NOVEMBER EACH YEAR.":PRINT
8040 PRINT"     B.  H U R C O N  4 :  A HURRICANE HAS BECOME A THREAT"
8050 PRINT"     TO THE ";II$;" AREA.  SURFACE WINDS IN EXCESS OF 50"
8060 PRINT"     KNOTS COULD ARRIVE WITHIN 72 HOURS.":PRINT
8070 PRINT"     C.  H U R C O N  3 :  A HURRICANE HAS BECOME A THREAT"
8080 PRINT"     TO THE ";II$;" AREA.  SURFACE WINDS IN EXCESS OF 50"
8090 PRINT"     KNOTS COULD ARRIVE WITHIN 48 HOURS."
8100 PRINT:INPUT"       PRESS ENTER TO CONTINUE";UU$:CLS
8110 PRINT:PRINT"          H U R R I C A N E   C O N D I T I O N S":PRINT
8120 PRINT"     D.  H U R C O N  2 :  A HURRICANE HAS BECOME A THREAT"
8130 PRINT"     TO THE ";II$;" AREA.  SURFACE WINDS IN EXCESS OF 50"
8140 PRINT"     KNOTS COULD ARRIVE WITHIN 24 HOURS.":PRINT
8150 PRINT"     E.  H U R C O N  1 :  A HURRICANE HAS BECOME A THREAT"
8160 PRINT"     TO THE ";II$;" AREA.  SURFACE WINDS IN EXCESS OF 50"
8170 PRINT"     KNOTS COULD ARRIVE WITHIN 12 HOURS.":PRINT:PRINT
8200 INPUT"     PRESS ENTER TO CONTINUE";UU$:CLS:GOTO3000
8500 REM  <<<<<<<<  PRINT "TOO LATE" MESSAGE
9000 CLS:PRINTCHR$(23):PRINT@132,"YOU ARE NOW IN HURRICANE "
9001 EE=FIX(LEN(A$)/2)
9002 IF EE/2<>INT(EE/2) THEN EE=EE+1
9005 PRINT@460-EE,"* * * ";A$;" * * *"
9010 PRINT@778,"G O O D   L U C K"
9020 FORX=1TO250:NEXT
9025 PRINT@778,"+ - + - + - + - +"
9030 FORX=1TO250:NEXT
9050 GOTO9010
```

```
DELETE ALL REMARK STATEMENTS
DELETE LINES:   550 TO 575
                1002
                2010 TO 2060
                3210
                3325
                8000 TO 8200
                9000 TO 9050
MODIFY LINES 605 AND 3010 TO THE FOLLOWING:
 605   PRINT "HURRICANE ";A$;" IS CURRENTLY ";D;" MILES
       FROM"
3010   PRINT "HURRICANE ";A$;" IS CURRENTLY ";D;" MILES
       FROM ";II$;"."
```

Fig. 1. Modifications to run program in 4K of memory.

should make a mistake, I have included some mythical hurricane inputs along with the resulting Hurricane projections (see Fig. 2), which you can use to check out your program.

Global Uses

Hurricane was designed to be used with northerly latitudes and westerly longitudes (i.e., the northern half of the western hemisphere, which includes the North American continent). If you would like to go one step further and track typhoons in the South Pacific or snow storms in Siberia, Hurricane can do that for you too. There are two basic rules you must use for global calculations:

1. If the storm, or whatever, is located in the southern hemisphere, you must input the latitude as a negative number.
2. If the storm is located in the eastern hemisphere, you must input the longitude as a negative number.

Any mixture of these rules may be used. If you live in other than the northern half of the western hemisphere, then the same rules apply for entering the latitude and longitude of your location.

Path Prediction

The use of straight-line predictions requires some clarification. If you assume that the earth is round, a straight line between your location and the hurricane will actually travel through the earth. In reality, we are finding the shortest distance between two points on the globe and calculating the direction, from true north, which you would have to head in order to take that route. The directional calculations are made from both locations in order to provide the necessary information for the Hurricane program.

I wrote the straight-line path-prediction portion of the Hurricane program for informational purposes in monitoring a hurricane and not for use in any type of official capacity. Hurricanes are extremely unpredictable, and the straight-line predictions will only determine if the storm is heading in your direction at that very moment. The odds of the hurricane traveling in a straight line toward your location for any long distance are unlikely (though possible). The program is, however, quite accurate (dependent, of course, upon the accuracy of the information you input) in the bearings and distances it calculates.

A word of caution is necessary when you demonstrate the Hurricane program: People are very gullible, especially when observing information presented on a TV screen.

I demonstrated the program during a recent computer faire sponsored by the Panama City Computer Society. On more than one occasion I was approached by sincere questioners who asked if the mythical hurricane I was using for an example was real and whether they should check with the local weather bureau for additional information and storm warnings. So be sure to be careful in demonstrating it, especially if there is an active hurricane in progress.

Acknowledgement

The spherical trigonometric equations used in this program came from an August 1973 *QST* article written by Jerry Hall, "Bearing and Distance Calculations by Sleight of Hand." Jerry had written the article for amateur radio operators as an aid in accurately pointing their beam antennas toward other amateur radio stations located in foreign countries. The calculations were done by hand from a book with a trigonometric table in it. There were no microcomputers in those early pioneer years, and the four-function, $100 calculator was just coming on the market.

Since then I've kept Jerry's article close to my heart, somehow knowing that the microcomputer was coming and that I would be able to use the equations faster than either the 15 minutes it took me to do the computations by hand or the four minutes by calculator. It didn't make sense that the foreign (DX) amateur radio station had to wait all that time for me to calculate whether my antenna was pointed toward it or not.

When the TRS-80 arrived in my home in January 1978, the time had finally come to computerize the equations in Jerry's article. They worked beautifully, with the TRS-80 sometimes taking as long as one second to do the computations.

With the coming of the hurricane season here in Florida, a close friend recommended that I modify and improve the program so that I could use it to monitor hurricanes. With the aid of some locally published disaster-preparedness information on hurricanes, I adapted the program for hurricane tracking and added the prediction capability.

Some Final Thoughts

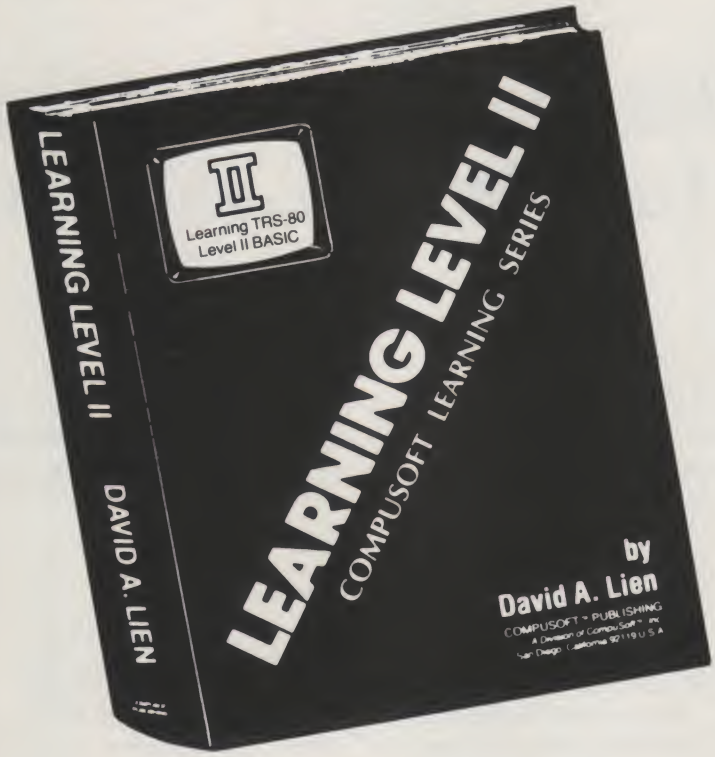
The spherical trigonometric equations used in Hurricane could easily be adapted for incorporation into many other programs. Because it calculates great-circle bearing and distance, it should be a great asset in navigational calculations to determine the shortest path, along with the distance in between . . . especially when the TRS-80 goes portable, or maritime mobile, whichever the case may be. As I mentioned above, it also lends itself to the amateur radio operator for assistance in pointing his beam antennas.

However you use it, the Hurricane program is bound to provide a global distance and direction computing capability never before available in the home. ■

```
INPUT:
   YOUR LOCATION          LATITUDE          LONGITUDE
      Panama City            30.2              85.8
   HURRICANE NAME         LATITUDE          LONGITUDE
         ANNE                12                90
   DIRECTION OF TRAVEL (IN DEGREES)       SPEED (MPH)
                66                           45
OUTPUT:
   HURRICANE LOCATION: 1285 miles south of Panama City
   BEARING FROM PANAMA CITY: 193 degrees from true north
INPUT:
   LATITUDE     LONGITUDE     DIRECTION     SPEED
      21           87             6           45
OUTPUT:
   HURRICANE ALERT
   HURCON 2 NOW IN EFFECT
   HURRICANE LOCATION: 640 miles south of Panama City
   BEARING FROM PANAMA CITY: 187 degrees from true north
   TIME UNTIL HURRICANE REACHES PANAMA CITY: 14 hours
```

Fig. 2. Sample run. Hurricane program verification.

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Video DMA Interface for SWTP Systems

Direct memory access adds speed and flexibility to the Southwest Technical Products Corp. CT-64 video terminal. The same methods should work with many other systems.

Dewey Holten
Jerry Boehme
Department of Chemistry
Washington State University
Pullman WA 99164

This article describes the design and implementation of a video direct memory access (DMA) interface for a Southwest Technical Products Corporation CT-64 terminal and 6800 computer system. The techniques and circuitry involved can be easily adapted to other computer systems and stand-alone terminals, and is not a final design. Basic ideas gave us a fairly simple circuit to experiment with in order to get a better feel for future hardware/software applications.

We will describe the video DMA interface itself, which gives greatly enhanced capabilities for the display of alphanumerics and limited graphics, with the resolution set by the character size. In conjunction with the mixed alphanumerics-graphics nature of the display, this resolution is more than adequate for computer games, graphs with labeled axes, bar graphs and other applications. Many more applications for both alphanumerics and moderate resolution graphics under DMA control will become obvious as we proceed through the design and construction of the circuitry involved.

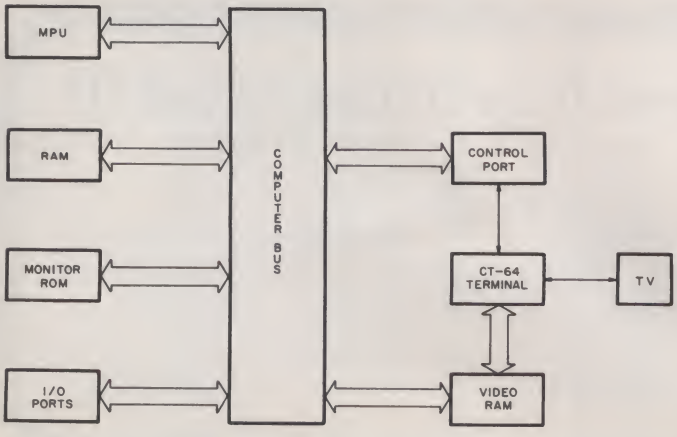


Fig. 1. System architecture.

Introduction

In essence, this interface gives a memory-mapped video display in much the same way the SWTP 6800 and other computer systems have memory-mapped I/O. Each character position on the screen corresponds to a specific location in memory, which can now be accessed directly by the computer for loading and retrieval of video data. For a display with 16 lines of 64 characters, which we used for this article, this gives 1K of programmable video output locations.

Many terminals, such as the CT-64, also have two of these user-selectable pages. (The circuitry will work for displays of any length with little or no modification.) Placing a selected character at a specific display location can then be handled by direct computation and processor register-to-memory and memory-to-memory transfer techniques at the program execution rate.

Previously, in order to display the same character, both the code for that character and the complicated series of cursor movements necessary to reach the desired location needed to be sent externally at the much slower computer/terminal transfer rate. Furthermore, the present design change allows the computer to use the display memory for computation purposes when extra memory is needed, thus making more efficient use of the existing hardware. Since we use memory already supplied with the terminal, this new feature can be incorporated for about $15 in additional components—no additional memory need be purchased!

The CT-64 has many useful features: 16 × 32 or 16 × 64 character displays, scrolling or page mode, reversed screen, screen read (an inherent property of the present design), individual character highlighting and software- and hardware-controlled cursor movements. Furthermore, 21L02 memory chips are used for both the computer and terminal display memory, making the layout of the new DMA system a bit easier to understand. The CT-64 also includes the circuitry to decode all 32 ASCII control characters.

When a control character is received from the computer or keyboard a low pulse of several μs duration is available at the appropriate control character pad on the main terminal board. These can be jumpered to flip-flops at other locations to control page flipping, cursor movements, cassette read and write

and numerous other user-defined functions.

Limited raster scan graphics result directly from the present design, since a blank or reversed (highlighted) space can be programmed at any of the 1K of character positions on a display page. For greatly increased raster scan graphics for the 6800, refer to David Koh's articles in the November and December 1978 issues of *Kilobaud* ("Raster Scan Graphics for the 6800"). Many of the DMA techniques are shared by both David's and our approach. He essentially allotted 5K of memory for a 256 × 160 dot resolution graphics display using an SWTP 6800 system, CT-1024 terminal and a minimum of additional circuitry.

We place the display of alphanumerics under direct MPU control, providing the user with greater flexibility for applications, such as rapid examination or editing of any block of memory or monitoring the execution of a program. For those who don't need high-resolution graphics capabilities or don't want to purchase more memory, this design will give an easy and inexpensive means of providing expanded display capabilities and becoming familiar with DMA techniques.

The organization of the system, including the video DMA interface, is shown in Fig. 1. The SWTP 6800 computer uses the S-50 bus. Subsets include the 16-line address bus, the 8-line bidirectional data bus, read/write, system clock and the other necessary signal and supply voltage lines. The MPU and memory boards share this common set of lines, as do the I/O ports after a certain amount of decoding. The signals to and from the memory boards pass through Tri-state devices to ensure, for instance, that data from only one memory board at a time is placed on the data bus. Since the S-50 bus uses bidirectional data lines, the direction of data transfer to or from the MPU (read or write) along the common data bus lines must be specified and requires special bidirectional Tri-state buffers.

In addition to the typical low-impedance output low and low-impedance output high states, the Tri-state device has a high-impedance state in which it is essentially disconnected from the bus. Therefore, with the enable control activated, the input information passes directly to the output, and with the enable unactivated the output assumes a condition where it presents no load to the bus line. This means we can wire-OR the outputs of many Tri-state devices on a common line, enabling only one device at a time. In setting up a common bus used by both the computer and terminal to access the two pages of display memory, we used a similar type of organization to that found in the computer.

The Computer Board

The schematics of the two boards required for the video DMA interface are shown in Figs. 2 and 3. The computer/memory board, which requires more assembly time than the terminal board, is actually composed of two sections. The first is the entire 2K (2 page) memory board that is presently connected to the CT-64 main terminal board via two 15-pin Molex connectors, J7 and J8. The second section is made up of the voltage regulators and 11 interface chips. The latter components provide the usual address and data bus interface and address decode circuitry between the memory and the main 50-pin computer bus, as well as the interface between the memory and the bus shared with the terminal.

We must first prepare the CT-64 memory board for placement onto the computer board. Some readers may wish to actually rewire the 2K of memory and page select flip-flop on the computer board (the design for more or less pages of display memory remains essentially the same).

However, we chose to use the CT-64 memory board intact, but with only minor modifications. The two 15-pin female Molex edge connectors J7 and J8 must be removed from the CT-64 memory board. (You can probably leave them on, however, if you have extras.) These female connectors will be used on the new terminal board.

The perforations on the computer board accommodate the usual 16-pin integrated circuit sockets. This hole pattern, however, is not compatible with that of the five 10-pin Molex edge connectors along the computer bus. This turns out to be only a minor difficulty since you can straighten the pins on the connectors, which are then epoxied to the top of the computer board.

Connections are made by running the wires along the back of the board from the appropriate IC pin to below the edge connector and up through a hole adjacent to the connector pin. A suitable connector with at least 33 pins must also be attached to the opposite edge and will be used for the interface bus to the terminal board. We chose a 40-pin ribbon cable connector for this purpose.

Now attach the memory board to the computer board via four holes in the corners of the memory board. Small pieces of copper wire make good feedthrough connections from the two 15-pin rows of holes (now called J7' and J8') on the memory board to the back of the computer board.

Tables 1 and 2 indicate connections for power and for Tri-state enable lines for computer access (C) or terminal access

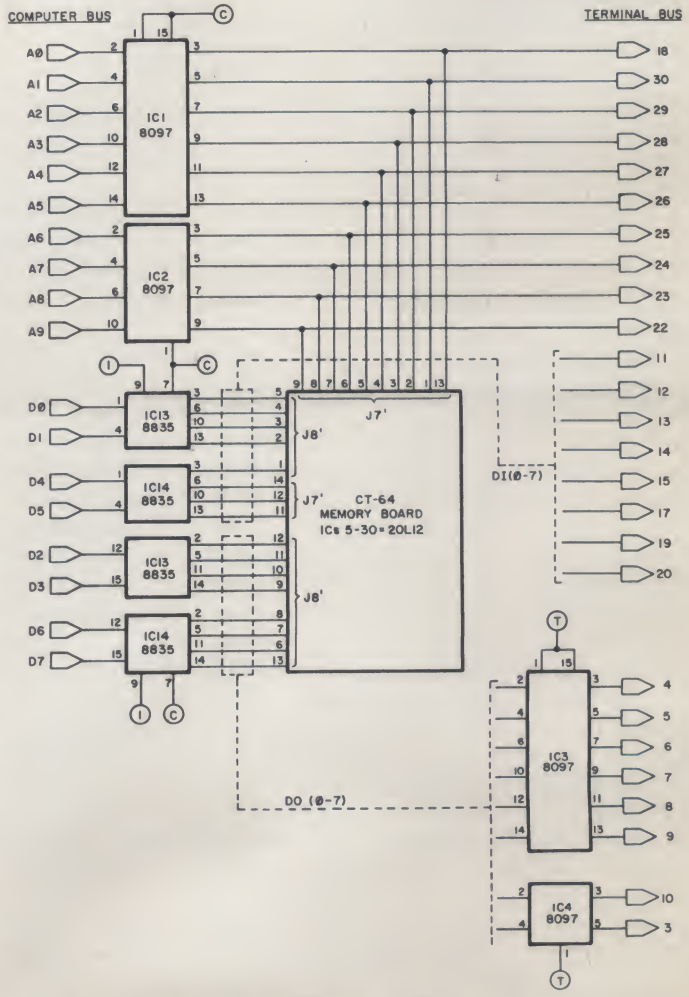


Fig. 2a. Computer board schematic. Point (1) refers to a connection of Fig. 2b. Points (C) and (T) are the computer and terminal select lines, respectively. Note that ICs 3 and 14 are bidirectional transceivers for the computer data lines. The entire CT-64 memory board, with connectors removed, is mounted on the computer board. Connection points to this board are relabeled as J7' and J8'.

(T) to the common memory. Non-inverting Tri-state buffers DM8097 (74367) are used for much of the interfacing. Inverting Tri-state transceivers DM8835 were used for interfacing the display memory data lines to the bidirectional computer data bus. Two 7805 (LM-340T) +5 V, 1 Amp voltage regulators mounted on heat sinks are used, one for the CT-64 memory board section and the other for the interface chips. The +8 V unregulated and ground are obtained directly from the computer bus. A 1 or 2 μF tantalum capacitor should be placed between the output and ground of each voltage regulator to provide bypassing.

The only other modifications to the CT-64 memory board section are to the page select flip-flop IC31 (Fig. 2b). Cut the foils from IC31 pins 5 and 6 to the chip enable (CE) lines of the lower row (page 2) and upper row (page 1) of 21L02 memory chips. Pins 5 and 6 of IC31 must now be connected to pins 10 and 12 (input) of Tri-state buffer IC4. The CE lines from page 2 and page 1 memory are then connected to pins 9 and 11 (outputs) of IC4, respectively, as shown in Fig. 2b.

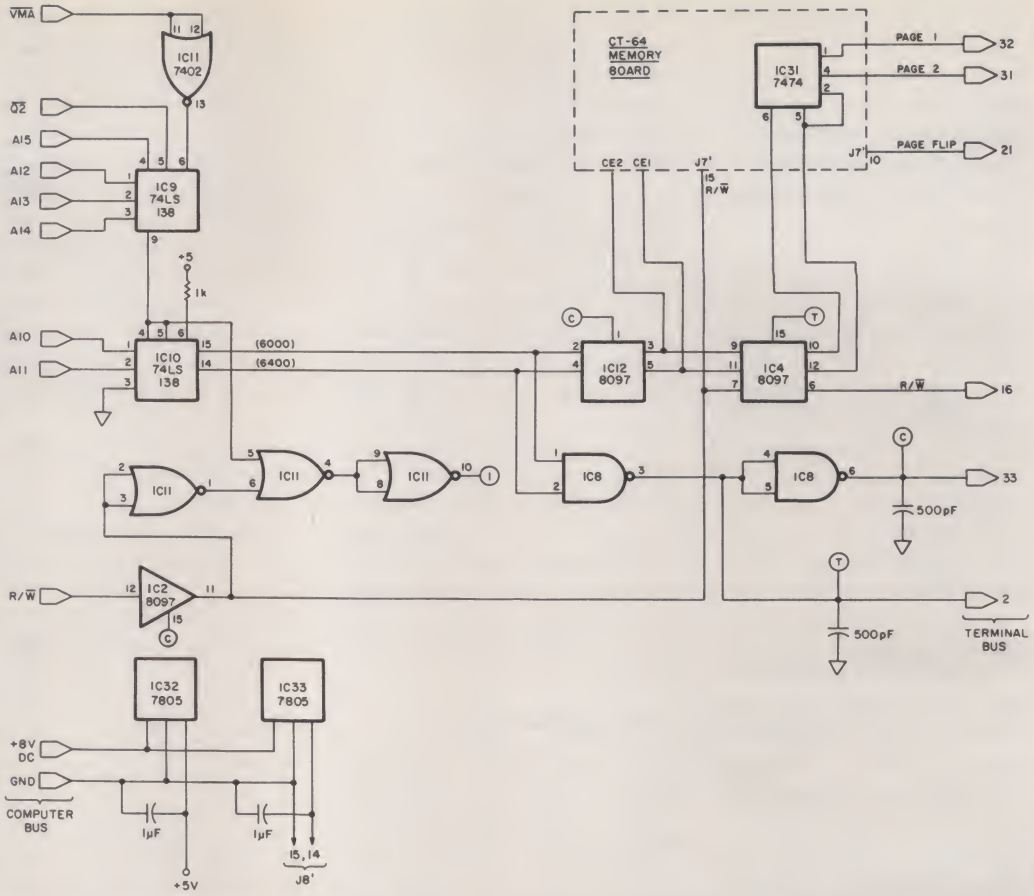


Fig. 2b. Computer board schematic. The connections to pin 5 and 6 of IC31 and the CE lines on the CT-64 memory board are described in detail in the text. Voltage regulator IC33 supplies +5 volts to the CT-64 memory board section; whereas IC32 is for the remainder of the IC on the computer board.

These CE lines are also connected to the outputs of the two buffers of IC12, which are, in turn, driven by the memory decode circuitry. Thus, these memory CE lines are part of the common bus, which can be accessed by either computer or terminal depending on the status of the Tri-state enable lines of ICs 4 and 12. The data in, data out, address and R/W lines are similarly shared by the two devices via Tri-state buffers ICs 1-7.

The address decode circuitry of Fig. 2 (ICs 9-11) is wired to allocate the following sequential memory locations (hex) to the computer board:

6000-63FF Page 1 of Display Memory
6400-67FF Page 2 of Display Memory

This can be changed to a different memory block by selecting a different output pin from IC9. (See the SWTP 4K memory board schematic.)

The terminal has normal access to the display memory, except when the computer reads from or writes into a location in display memory. Under the latter conditions, the valid memory address is decoded on the computer board, forcing low either pin 1 or 2 of NAND gate IC8, depending on which page of memory the address is located. The pin 3 output of IC8 goes high, disabling all terminal address and data lines through Tri-state enable line (T).

After being inverted in a second NAND gate, the computer Tri-state enable line (C) goes low, allowing the computer access to the display memory, i.e., during this read or write operation. Note that the combination of IC8 NAND gate ensures that only one device at a time can access display memory.

The Terminal Board

The terminal board contains three Tri-state buffers (ICs 5-7) necessary for the terminal/memory interface. These chips are placed on the terminal board because they also act as drivers to maintain logic levels through the 40-pin cable to the computer board. The two 15-pin Molex connectors are placed at the J7 and J8 locations, and the appropriate bus connector should be attached to the top of the board. The schematic for the terminal board is shown in Fig. 3. We reserved a lot of empty space on the terminal board for increased graphics resolution circuitry; however, we decided to put that circuitry on another small board in the terminal. (Note that, depending on the layout, it might be better to place ICs 5-7 on the computer board also, if the 40-pin cable is not excessively long. We have used this approach successfully on a second interface.)

A useful page-selection feature can also be added. An SPDT center-off switch is mounted on the terminal cover. The center pole is connected to ground and the outer poles to page 1 and page 2 lines (40-pin bus #31 and #32). The center-off position allows automatic or control-character-generated page select. In either of the outside positions the appropriate page of memory is displayed.

Checkout

At this point the video direct memory interface should work; however, you may notice some flickering occurring during the time the display memory is being accessed by the computer. This can be eliminated by blanking the video output during this time (see Fig. 4).

To test operation, simply load the ASCII code for the character to be displayed in the desired display memory location by using the MIKBUG memory examine/change function. Recall that the ASCII equivalent can be obtained by ANDing the hex code with $30. For a 16 line ×64 column display the first

IC	Type	+5	GND	+5 Source
1-4	DM8097 (74367)	16	8	IC33
5-7	DM8097	16	8	Terminal
8	7400	14	7	IC33
9	74138	16	8	IC33
10	74138	16	3,8	IC33
11	7402	14	7	IC33
12	DM8097	16	8	IC33
13,14	DM8835	16	8	IC33
15-30	21L02	10 (a)	9 (b)	IC32
31	7474	14 (a)	7 (b)	IC32

(a) Via pin 14 J8'
(b) via pin 15 J8'

Table 1. Power connections.

IC	(T)	(C)
1,2	-	1,15
3-7	1,15	-
8	3,4,5	6
12	-	1
13,14	-	7

Table 2. Tri-state enable connections.

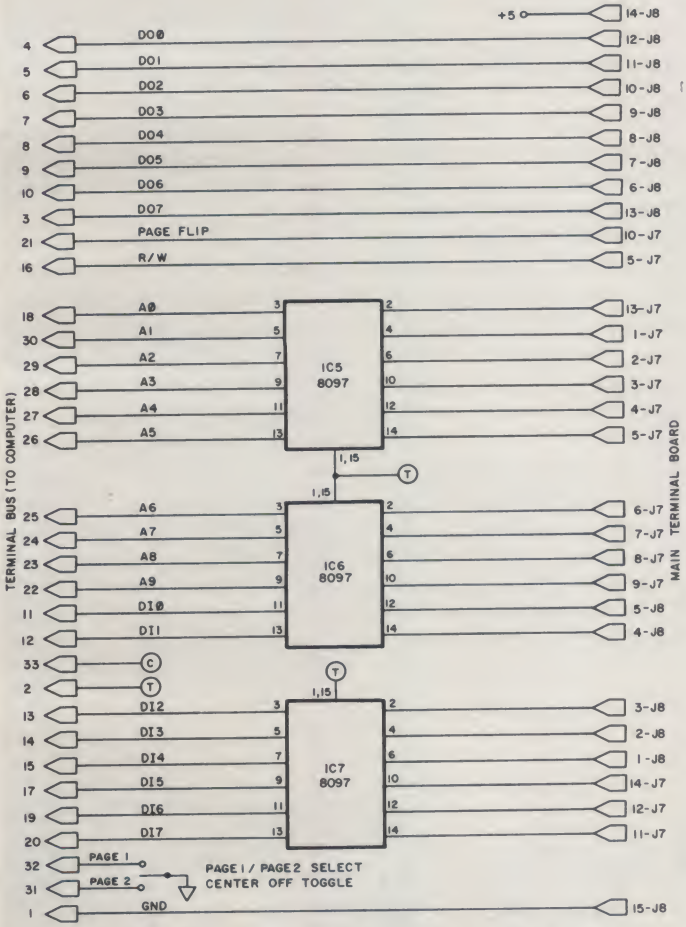


Fig. 3. Terminal board schematic. Points (T) and (C) are the terminal and computer enable lines.

row comprises locations 0-63 ($00-$3F), the second, 64-127 ($40-$7F), and so on. These values are to be added to the appropriate address for the start of the page ($6000 or $6400 in the present design).

Sometimes it helps to first clear the display page. We connected the INIT pad on the main terminal board to CTRL A (ASCII code 01) for this purpose. Be sure to remove C33 and D7 from the main terminal board if INIT is connected to a control character, as explained in the CT-64 documentation. If you have only one page of memory on the CT-64 memory board, then ground the page pad for the unused memory block.

If you encounter problems, be sure to check all connections to the memory board and address decode circuitry. If you have two pages of memory, you can give a memory test to one page, while viewing the results on the second.

Software

Undoubtedly, the video DMA system will find the most frequent use with a language such as BASIC. You can take advantage of the available computation power to control the details of the display and to add graphics capabilities.

Listing 1 gives one such BASIC demonstration program. It requires a version containing a memory (POKE) command, which is used in statement 510 to load the ASCII character codes into display memory. You will find this program slower than machine-language programs because the POKE command requires a decimal-to-hexadecimal conversion. The PRINT CHR$(01) commands of line 20 are used to initialize the terminal with a homed-up cursor and clear page. The control code 01 is decoded by the terminal and is used to drive the INIT pad located at the rear of the main terminal board as mentioned above.

This BASIC program simply draws horizontal and vertical axes, labels them and produces a simple line curve. You can get a feel for the interface by drawing numerous other types of curves with the mathematical functions offered by BASIC. You may want to use a different routine for defining the coordinate system on the 16 × 64 grid.

The CT-64 uses bit 7 from the keyboard (an extra switch) or from the computer to generate individual character highlighting. A highlighted space will therefore give a white position on the black screen or a black position on a white screen, depending on the status of the entire-screen reverse function. This highlighted (reversed) space can be used for limited "point" graphics with the resolution being set by the cursor (character) size.

Remember to connect the bit 7 lines in and out of the UART on the CT-64 serial interface board. To get a highlighted character, simply store the *appropriate* ASCII code (with bit 7 = 1) in display memory (normal space = $20, highlighted space = $A0).

The CT-64 Main Terminal Board

The feature for video blanking during computer access to the display memory is quite simple to implement. It makes use of a previously undefined gate on the main terminal board. (Depending on your TV or monitor, this feature may not be necessary.)

Fig. 4a indicates the necessary connections on the CT-64 main board. The cursor and video dot data appear at the output (pin 8) of exclusive OR gate IC31C. By cutting the foil leading from this pin you can reroute the video data to one of the inputs of unused AND gate IC29B. The output of IC29B is then connected to the inputs of IC17A, which were previously connected to IC31 pin 8. The

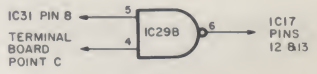


Fig. 4a. Modification to the CT-64 main terminal board for video blanking during computer access to the display memory.

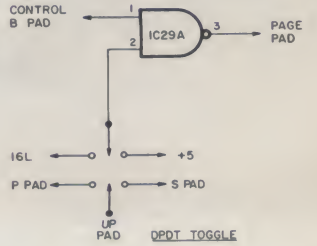


Fig. 4b. Display page selection modification.

```
0005 REM DMAAXES TEST PROGRAM
0010  P1=24576:REM PAGE 1=$6000
0020 PRINT CHR$(01);CHR$(01)
0025 REM A$(X) IS DISPLAY NUMERAL
0030 DIM A$(14)
0040  A$(1)="1":A$(2)="2":A$(3)="3"
0045  A$(4)="4":A$(5)="5":A$(6)="6"
0050  A$(7)="7":A$(8)="8":A$(9)="9"
0055  A$(10)="0":A$(11)="1":A$(12)="2"
0060  A$(13)="3":A$(14)="4"
0070 REM X0 AND Y0 DETERMINE ORIGIN
0075 REM ON 16 X 64 GRID
0080 REM SEE LINE 500
0085  X0=0:Y0=0
0090  X=2:A$="+"
0095 REM A$ IS DISPLAY CHARACTER
0100 FOR Y=4 TO 14
0120 GOSUB 500
0130 NEXT Y
0140  Y=14
0150  A$="-"
0160 FOR X=2 TO 60
0170 GOSUB 500
0180 NEXT X
0190  Y=14
0200  A$="+"
0210 FOR X=2 TO 60 STEP 4
0220 GOSUB 500
0230 NEXT X
0240  X=0
0250 FOR Y=4 TO 13
0260  A$=A$(14-Y)
0270 GOSUB 500
0280 NEXT Y
0290  Y=15
0300  Q=0
0310 FOR X=6 TO 60 STEP 4
0320  Q=Q+1
0330  A$=A$(Q)
0340 GOSUB 500
0350 NEXT X
0360  Y0=14:X0=2
0370  A$="*"
0380 FOR X=4 TO 60 STEP 4
0390  Y=1+INT(X/7)
0400 GOSUB 500
0410 NEXT X
0420 END
0490 REM PLOT ROUTINE
0500  L=P1+ABS(64*(Y0-Y)+ABS(X0+X)
0510 POKE( L,ASC(A$))
0520 RETURN
```

Listing 1. BASIC demonstration program.

other input of IC29B is then connected via a jumper wire to the computer (C) select line on the terminal board (pin 33 of the 40-pin connector).

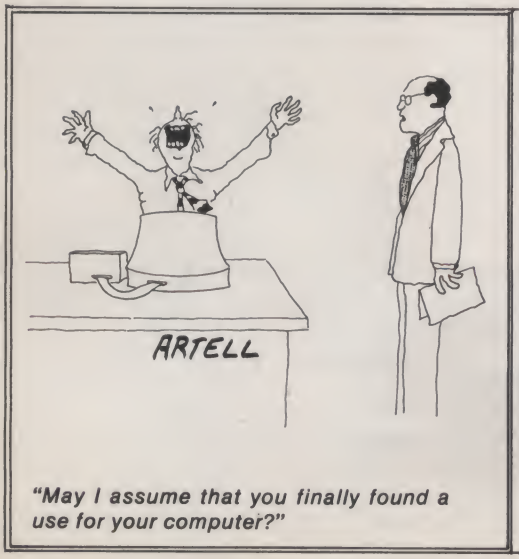
It will be necessary to first cut the common foil grounding pins 4 and 5 of IC29. (You may also wish to cut the foils at pins 1 and 2 of IC29 if the page-flipping feature described next will be incorporated.) For AND gate IC29, if either input is low, the output will be low. When the terminal has access to the display memory, IC29 pin 4 will be driven low. This will force the output of IC29 low, causing a blank screen.

The other unused AND gate, IC29A, can be employed in another useful feature as illustrated in Fig. 4b. As mentioned above, the page 1 and page 2 lines on the terminal board are connected to an SPDT center-off toggle switch (not shown in Fig. 4). When the page switch is in the center position and the DPDT scroll/page switch is in the page position, automatic page flipping at the end of a page occurs. Pad 16L goes low at the end of a page to accomplish this.

If you wish to defeat automatic page flipping, then select the desired page with the SPDT page switch. Automatic flipping will likewise be defeated during the scroll mode. Control-character-generated page selection is allowed in either page or scroll modes as long as the page select switch is in the center-off position. A control character other than CTRL B can be used for this purpose. We find all of these options useful in management of the two pages of display memory.

The minimum system presented above is intended to be a low-cost and easily implemented solution for the limited display capabilities of typical stand-alone terminals. There are numerous opportunities for design changes, and we have already mentioned a few of these. Programming for specific applications, such as moving displays that can be externally controlled, is the best way to get the feel for the memory-mapped display capabilities. This will also provide a means for determining future expansion.

We have presented a short program as a prototype. One obvious use of the new capabilities is rapid memory dumps (rapid transfer of core memory to display memory), editing and retransfer. With increasing use of the video DMA interface, you will find that many display operations carried out with the slow, external computer/memory transfer can be performed faster, more efficiently and under greater control under the present design. ■



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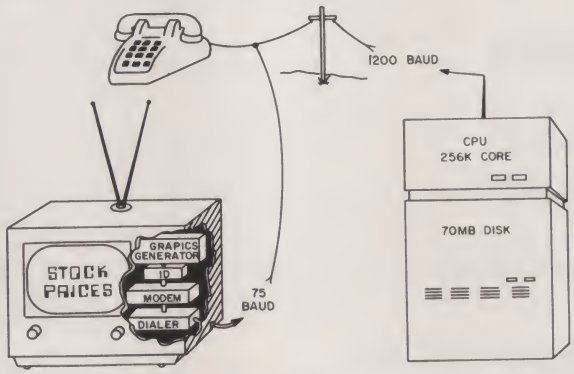
Frank J. Derfler
PO Box 17283
Montgomery AL 36117

The Ultimate Consumer Computer

Prestel, a "viewdata" system for bringing computer usage into homes and businesses in Great Britain, was implemented by the British Post Office in January 1976. In July 1979, it was announced that GTE has been licensed to offer an American version of Prestel.

You are about to read a description of the system that may put a cap on the growth of consumer-style small computers in the industrialized nations of the world. We like to talk bravely (but perhaps with some secret hesitation) about bringing computer power into every home. While we in the U.S. talk, government authorities in several European and Asian countries are doing something about it.

Since January 1976, the British Post Office has been bringing computer power into many homes and offices in Great Britain. The BPO's Prestel system makes unique use of two familiar communications devices in the home—the TV set and the telephone—to bring versatile data handling and retrieval service to a rapidly growing number of customers.



How Prestel works.

How Prestel Works

The accompanying block diagram shows how Prestel is configured. The heart of the system is a relatively small (256K core) computer manufactured by General Electric Co. Ltd. of England. This machine runs a program that executes communications control and such functions as user ID verification and billing. Its key element is 70 to 280 megabytes of disk space. The computer has numerous dial-up access lines that come in from the normal voice telephone exchange system.

At the user (home) end, the family's TV set doubles as a computer terminal device. Normally, the TV is bought factory modified so that it can be used as a terminal with the push of a button. The additions (which could be outboard) are: an autodialer, which calls the computer when the Prestel mode is selected; a 75 baud transmit and 1200 baud receive modem; and a small amount of ROM/firmware, which contains the character set (which could include Russian and other alphabets) and provisions for sending six different digits from a keypad down the 75 baud line.

In practice, the user simply pushes a button on the channel selection panel. The autodialer and ID get him on the computer using the normal home phone line ("Get Junior off the blower, Mum, I want to use the telly."). He can then either work his way through an extensive series of menus or immediately select the number of the page (just as in a newspaper) of information he wants.

The TV display he sees has about the same graphics and color impact as the Apple II. The big difference is that he has many megabytes of constantly updated information to back him up.

As we well know, a computer system is nothing without software. Generally, microcomputer systems have it all over Prestel in the area of specialized number crunching. If you do a lot of curve fitting and stress analysis, then a dedicated system would serve you better. Also, if you need your own unique data base, a dedicated system is a must.

Prestel Services

Prestel puts you into the public data base in an interactive mode. This public data base includes everything you see in the daily papers. It also includes near real-time stock and racetrack reports. Airplane and train schedules, encyclopedias, recipes, specialized corporate news (either for public or restricted access) and a host of other kinds of information is available. Services (interactive computer programs) such as loan balance, investments, checkbook and, yes, even games will be added to the system by early 1981.

The BPO is entering a market trial phase during which they will greatly increase the number of customers. They will establish ten computer centers during 1979. Each center will serve customers in a local calling area. Over 300 companies have contracted to be information providers. These include major newspapers (the *New York Times*), retailers, investment and financial firms and even "umbrella" organizations that buy blocks of space (a minimum of 100 pages from the BPO costs about $2500 per year) and resell it to smaller users.

Late in the year, users will be able to send specific orders (adding a credit card number) or requests for further information to the retailers by using their keypad. Even betting is possible, but collecting is between you and the bookie or retailer; the BPO only supplies the communications channel.

Another feature coming in the near future is the capability of sending pre-formatted messages from one subscriber to another. Messages such as "I will arrive at . . . ." or "Call me at . . . ." can be selected, filled in and placed in a file for another terminal. This system is similar to mailboxes on other time-shared systems, except that the originators have only limited numeric pads for input. If required, standard keyboards are available for users.

Application

The key to the acceptance of consumer-oriented computing

is cost. The cost must be low enough so that the system leaves the category of "adult toy" and becomes an accepted major appliance. Prestel achieves this by using in-place phone lines and television displays in a dual-purpose role and by billing the user by the amount of use.

The added electronics needed to make a TV set into a Prestel terminal presently doubles the price of the set. This cost is expected to drop rapidly as larger production runs are made. An add-on converter is being produced, but the economics of TV in Great Britain is such that the majority of receivers are leased. In practice, the old receiver is swapped for a new modified one, and the amount of the monthly lease is increased.

The Prestel service is paid for on a page-by-page basis. Each page of information (not indexes) has a use charge, which is levied by the company or service that provides the information. The charge, which varies between one-half and 30 U.S. cents per page, is shown on the index so the user knows the price of a selection before he makes it.

Many pages are, of course, free. These may contain commercial messages, surveys or complementary services (compute payments or future value of deposits, etc.). An important part of the central computer's software is involved in keeping track of any appropriate charge for each page selected. A current bill is always available for the customer's viewing (that's a free page too).

Other Countries

The generic name for the kind of service Prestel provides is viewdata. Before I lead you to believe that the BPO, or even the British in general, are alone in bringing this technology into people's homes, I should mention the other forms of viewdata that are maturing almost as fast.

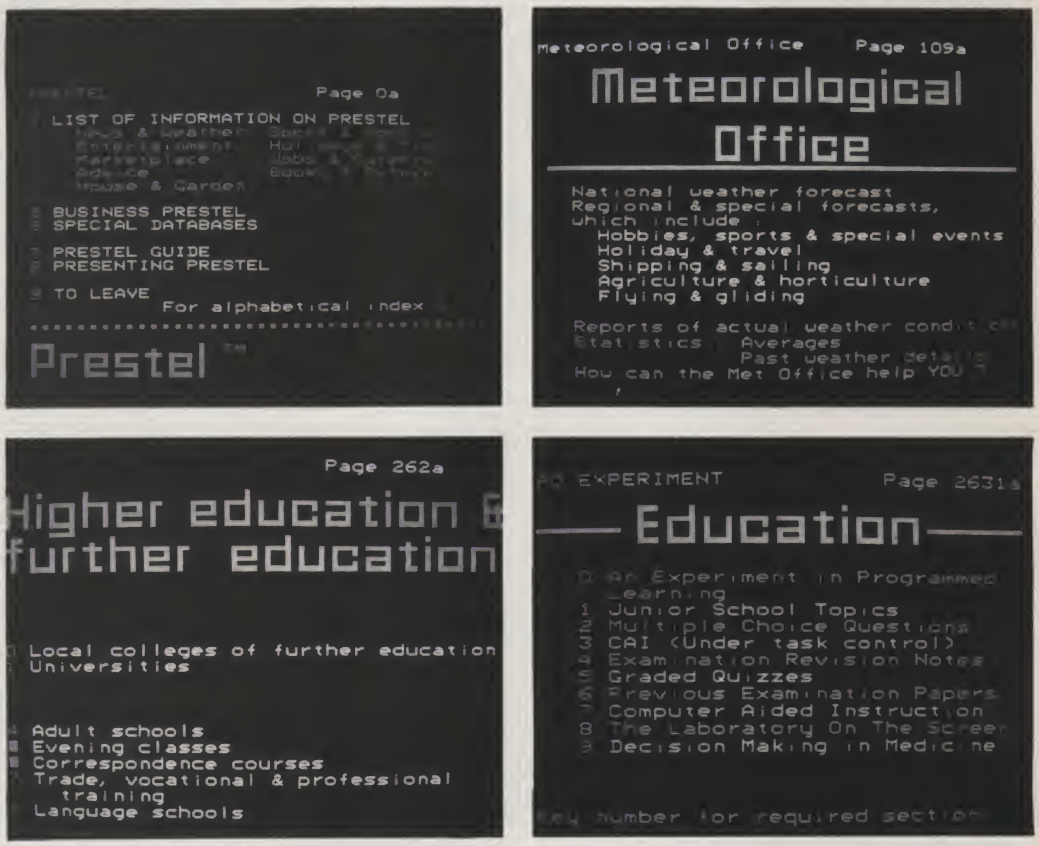
There exist competing British systems that use the flyback time on regular television broadcast signals to transmit the video information. The Japanese are well along the way with a system called Captain, which will be available to about 1000 subscribers in the Tokyo area sometime in 1979. The German Bildshirmtext is being based on software purchased from the BPO. Captain has about 100,000 pages of text available. One of Japan's goals includes production of a $500 adapter unit. Some of the biggest names in the Japanese electronics industry are involved in this project, and there is no reason to believe they will not reach their goal quickly.

The French are also developing a viewdata system. Almost predictably, they are lobbying for a set of standards and formats different from what most of the other countries are using. Prestel software has already been sold to West Germany and the Netherlands. Switzerland, Finland, Sweden and others are negotiating seriously. When I talked with John Darkin, the manager of international marketing operations for Prestel, he also mentioned that several of his sales representatives had plane tickets to Moscow in their pockets.

As you read the preceding paragraphs, you may have looked for some mention of the major Western industrialized nation with the largest (and best) telephone system, the greatest number of television sets and the largest appetite (mania?) for information in the world. You looked in vain. The countries involved in the viewdata evolution have one thing in common: a government monopoly telecommunications system that doesn't discriminate between transmission media and special services on that media.

In order to build the world's best telephone system, the U.S. had to develop a similar "protected market" situation. More recently, we seem to have become ashamed of big business, and we have tried to regulate equality. That these new regulations have been beneficial in some areas is beyond question, but they have also stood in the way of the large-scale corporate cooperation needed to bring viewdata service to the U.S. mass market. The regulatory ins and outs are beyond the scope of this article, but straight-line extrapolation says that it will be a long time before regulatory restrictions ease. (Breakthroughs are possible.) Some cable television companies have considered small-scale viewdata operations, but their data base would probably be tiny in comparison.

The Digicast project, which exists in the minds of some serious computer folks in the environs of Stanford University, is probably the closest thing to the viewdata concept in the U.S. This system would be broadcast on the sub-carrier of standard



The Prestel menu can lead the user through the thousands of available pages. The unique educational and weather services shown here are possible because of the large disk space open to each home terminal.

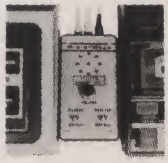
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The Micro-Mega CPU Monitor gives a voice to the Z-80 microprocessor in your TRS-80 by using AM radio circuitry to pick up the computational rhythms of the CPU, which are amplified and playad through a loudspeaker. The pickup unit of the CPU Monitor, shown at left in the photo, goes under your TRS-80 keyboard. It is connected by a 36" cable to the speaker and control unit, which includes an on/off volume control and an LED "power-on" indicetor. The Monitor is powered by an AC adapter, shown at right in tha photo. No batteries are needed and no electrical connections to your TRS-80 are required.



By listening to the CPU Monitor, you will soon become femilier with the "parsonelities" of the programs you run and whether thay ere executing in e normel wey. A dramatic use of the CPU Monitor is in the great enhancament which it provides for computer games. (See "Geming Environment" below.)

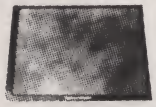
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Your mission is to rid the region of Klingons and to locate five inhabitable planets, all within 300 stardays, before returning to Star Fleet Headquarters where your overall effectiveness as a starship commander will be scored. High scores are possible only with carefui planning and effective battle tactics. The "Voyega Log" sheets will guide your strategy, and the "Torpedo and Maneuvering Chart" will give you a vitel edge in combat. (Whan you engage three Klingon ships you can't afford to miss.)

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Suddenly, you break out of hyperspace and your monitor displays tha chilling sight of three Klingon Battle Cruisers floating on your screen! Their avil shapes glow in luminous green against the black void of spaca. Momants latar, you haar tha charectaristic rasping sound of Klingon laser waapons, and, es you watch, high-energy beams come knifing toward the Entarprise in succassion from each of the Klingon ships.

You have been hit! You hear the dismal sound of the damage control alarm as "DAMAGE TO WARP DRIVE" and "DAMAGE TO PHASERS" flash on your screan. The Klingons have stopped firing! The Enterprise is crippled, but your best weapon is still intact, and it's your turn now! You key in the command for photon torpedoes. As your screen again displays the position of the Klingon ships, you select a firing vector from your torpedo chart and kay it in. Now you hear the buzz of your photon torpedo as you see it speeding toward a Klingon ship. It strikes him dead-canter! As you watch, the Klingon Battle Cruiser disintegrates, accompanied by a satisfying crackling sound.

Does the above scenario sound far-fetched? Not at all. It's a small sample of what you will experience with Micro-Mega's Gaming Environment, which consists of: ● The STAR TREK PACKAGE ● The GREEN-SCREEN and ● The CPU MONITOR. The fast-paced and dynamic action reflects the superb Star Trek III program together with the "Voyage Log" and "Torpedo Chart" of the Star Trek Package. All of the unique graphic displays are greatly enhanced by the Green-Screen. Finally, the uncanny sound effects are produced by the CPU Monitor, which faithfully picks up the FOR, NEXT loops and other CPU patterns, which create the distinctive siren sounds that accompany the ALERT and DAMAGE messages along with the harsher notes of the weapons salvos. Once you've tried it, you won't any longer be satisfied with silent computer games.

Remember that with the Gaming Environment you also get all of the other excellent features of the CPU Monitor and the Green-Screen for non-gaming applications. You also save $5.00 off the combined cost of the individual items.

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commercial FM stations. But for now, they are planning to operate in a distributed processing mode. The raw data base would be broadcast, and each customer would use a "smart" receiver (FM tuner feeding a microcomputer) to sort and present the data according to instructions contained in local programming. This is an interesting concept in that it puts the data base in the sky and allows the user to pick out what he wants, but it doesn't seem to have the economic incentives (and therefore growth potentials) built into it that viewdata/Prestel does.

Digicast is a different approach that may be valuable at some future time when users can add to or modify the data base, but for now it lacks commercial attractiveness. The centralization of the viewdata systems may not appeal to home computer hardware buffs, but it has great software advantages.

Certainly, the software associated with a viewdata system is not difficult to write. The hardware is well within present production capabilities, but someone with a lot of money and horsepower will have to orchestrate the regulatory and commercial problems before the system comes to the U.S.

The Future of the Microcomputer Industry

My prediction is that where viewdata comes, personal computing through the use of microcomputers will not flourish. But, at the same time, the use of computers in small businesses will grow strongly. My reasoning relies on the observation that most home computer users really don't need or develop their own data base. They may have a lot of programs, but they probably don't have anything in the way of unique data that cannot be stored as easily on 3 x 5 cards. Access to these same programs, plus the availability of a huge public data base, would clearly provide more value than a microcomputer system in the same general price range. Certainly all viewdata terminals don't have to be "dumb."

Those of us interested in hobby hardware may be able to have our cake and eat it too, but small-computer makers and sellers will generally find themselves crowded out of the home market by the big appliance manufacturers. The small-business market will benefit, however, from the psycho/sociological impact of having computing power available in the home. As people become more accustomed to interacting with data display devices, they will lose their fear of the technology and look for more services outside the home.

Right now we tend to think of small-business computers as aids for bookkeepers. Public familiarity with the viewdata type of display may eventually allow use of small-computer systems as aids for sales clerks too. Product information can be made available on many terminals around the store. Customers can use their viewdata skills to gather detailed information about the products or services offered. The local store computer (a micro will handle several terminals) can lead a hardware store customer through the process of selecting just the right nut and bolt for the job. The local data base can then tell him which aisle it is in and how much it costs.

The smart businessman or programmer in the small-computer field right now can anticipate change and get out ahead of it. Remember, a leader is just someone who is out ahead of the pack running in the same direction. The lesson of Prestel is that big homogenous populations (home users) can effectively utilize a large centralized data base. Microcomputer systems are best for small users with a unique data base. Run in that direction.

For a while, we in the U.S. may continue to play with embryonic networking schemes and to mail each other "magazines" on cassette tape, but we should know that there is a great wave building off either shore. We can either grab a board and ride the curl or be wiped out before we even see it. Keep your eyes on the horizon because viewdata may be here soon. ■

We're about to make a new name for ourselves.

Not that the old one was so bad. As Ithaca Audio, we've made quite a name for ourselves. As the source for CPU, memory, video display and disk controller boards to upgrade other makers' mainframes and peripherals. The company that makes those neat little RAM expansion kits. And the folks behind the world's only Z-80 Pascal compiler.

But as much as we've enjoyed improving other people's equipment, we've been quietly moving towards larger endeavors, with a lot of encouragement from our customers. Listening to people's problems, as well as their needs. And, as a prime mover behind the IEEE S-100 Bus Standard, answering some really knotty questions.

One of the results is our new identity. And our first new product: the Intersystems DPS-1. An IEEE S-100 compatible mainframe with features that live up to its looks. *Dependable* operation to 4 MHz. Twenty-card capacity. A modular power supply. And something no one else has—built-in breakpoints to give you a faster, more powerful tool for testing software as well as hardware. *Directly* accessible from an easy-to-use front panel that's as *reliable* as it is functional. In short, an intelligently-designed computer for the intelligent user.

There's a lot more to Intersystems. In hardware. And software. All available through the nationwide dealer network we're now assembling.

You can watch this magazine for updates. Or contact us directly for straight, friendly answers and detailed information from key staff people. Just the way you always have. Because even though we're making a new name for ourselves, we'll never forget who made it possible.

InterSystems

Ithaca Intersystems Inc.
1650 Hanshaw Road/P. O. Box 91
Ithaca, NY 14850/607-257-0190



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Bill Harvey
204 Vienna Drive
Milpitas CA 95035

The Exatron Stringy Floppy

The ESF is a device for those who don't want a cassette system and can't afford a disk.

At some point, your system will outgrow its memory to store all those "neat" programs. In the meantime, you have to suffer through waiting for your cassette (or, heaven forbid, your Teletype!) to load and store your creations. At present you have a Super 13.978K Ultra-Extended BASIC (FORTRAN, COBOL, Trek game, etc.) that loads in under two (or maybe 20) minutes . . . if you have set the tape counter correctly and remembered to switch off the pause control . . . if the volume and tone controls have not shifted since last time you used them . . . and if your little brother has not used the tape to record secret messages! That is, after you rewind the cassette (45 seconds), because the program you want *is always* on the other side. It may be time to look for something a little bit faster.

Have you got $700 to $1100, 16 hours for assembly time and the patience of Job to interface that "great" software—all to invest in a mini-floppy? No? Well, have I got just the thing for you.

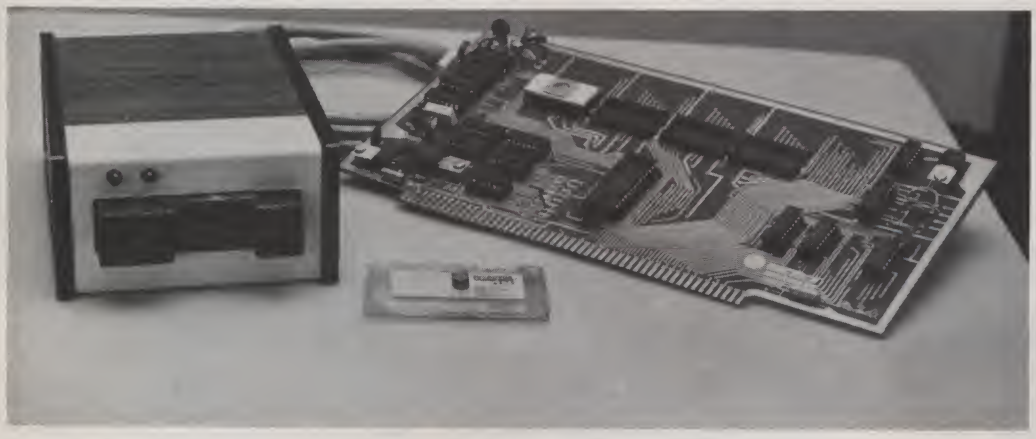
How does 7.2K bits/sec transfer rate sound . . . full software control of transport in EPROM (2708) . . . 45,000 bytes of storage per wafer . . . three extra EPROM sockets for your own use . . . completely assembled, tested and ready to run (plug it in, turn it on and GO!) . . . and it really works . . . all for less than $300? Sound like a possible winner? Read on, friend.

The ESF Package

The item under discussion is the Exatron Stringy Floppy. Exatron is the maker of a line of industrial automated IC testers and three computer products: the Exatron Stringy Floppy (ESF), an unusual 36K RAM/EROM Memory Card and a soon-to-be-released EPROM Programmer, all S-100 bus oriented. In plain English, the ESF is a completely assembled and tested endless-loop-tape mass-storage system complete with transport, controller/EPROM software printed circuit board (presently available as an S-100 bus card suitable for 8080 or Z-80 operation. Exatron is now advertising one for the SWTP 6800), 6K assembler-editor monitor and several blank tape wafers.

With the ESF is included a complete head cleaning kit to ensure long lead life. The owner's manual, sold separately so that potential purchasers can determine the suitability of the ESF Mass Storage Subsystem for their proposed use, contains one of the most complete descriptions of a computer product I have ever seen. The manual contains a description of the product, installation and checkout, operation (general), utility program descriptions with flowcharts (24 pages of flowcharts alone!) and a complete source-code listing of the software, troubleshooting procedures for transport and controller, plus manufacturer data sheets for the LSI chips used in the ESF—an excellent value in itself.

Both the manual and ESF are supplied with a 30-day money-



Complete Stringy Floppy system as received with transport, controller, PC board and test wafer. The white IC is the 2708 software EPROM with room for three more 2708s on board. Addressing must be in the same 4K block, typically B000 or D000.



My home-brew system with (left to right) cassette recorder, console/CRT, Exatron Stringy Floppy and paper-tape reader. The mainframe is mounted in the homemade desk behind the door in the lower right.



Close-up of peripherals.

back guarantee. The ESF comes with a one-year normal-service warranty. And with a $10 second-year membership in the Exatron Stringy Floppy Owner's Association (ESFOA)—the first year's membership is included with the owner's manual—you get a second year's warranty for the ESF. Unheard of, you say? Too good to be true? My initial thoughts exactly.

My first introduction to Stringy Floppy was at a local computer repair/design shop where a Stringy Floppy was being custom-fitted into a demo computer. Not having the aforementioned $700 to $1100, and as I was looking for an alternative to my cassette system, I investigated further.

I went to Exatron to purchase an owner's manual and to check out the company behind this unusual product. I was welcomed in by Bob and Mike Howell, the owners/operators of Exatron. After a long discussion and a short tour, I was on my way home to study my owner's manual in preparation for the Saturday-morning users group meeting, of which I was now a member. I figured this was a chance to seek out disgruntled owners and find the product's weaknesses! No such luck, though.

Everyone there had had good luck getting the ESF running quickly with almost no problems, save one experienced by a user with a Z-80 System. He later discovered a defective dynamic memory card that, when removed, improved his success rate significantly.

The ESFOA also issues a professionally produced monthly newsletter that is distributed to all members. Topics include interfacing techniques for popular BASICs, save-load routine descriptions for the assembler, utility-software routine summaries and topics of discussion at the ESFOA Saturday meetings.

With the product seemingly standing head and shoulders above the competition in relation to value for money, I plunked my money down. In only four days I had my Stringy Floppy, and off I went to ponder, "Why doesn't it work?" You see, I have a Turn-key, home-built, S-100 bus system, currently running a TDL Z-80 CPU with 25K of static RAM, 1K of PROM, 32-character-per-line CRT with keyboard, cassette interface and paper-tape reader. Nothing, especially software, seems to be readily compatible with my system. So a hardware/software combination could never work without modification.

Surprise! It worked the first time! The only modification required was a change in software to move the error display from the front panel to my CRT. Even this is in RAM, so no EPROM change was required.

Installation and Testing

Let me describe a typical installation and checkout of an ESF. The box that the ESF arrives in has a cut-to-fit foam liner that offers excellent protection during transport. The package contains the Stringy Floppy Transport, hard-wired to the controller printed circuit board and a head-cleaning kit. Several wafers, one with the assembler/editor to start you off, are also included.

Following the instructions in the owner's manual, insert the controller into an empty slot in your S-100 bus. The three-foot interconnect cable allows convenient placement of the tape transport. Check to see that you have no memory or other

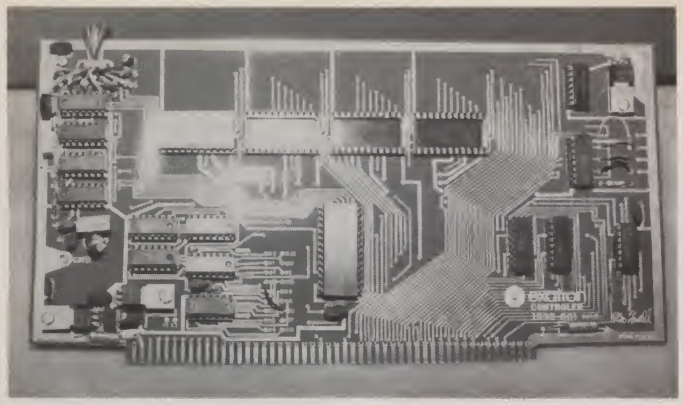


Stringy Floppy tape transport with wafer ready for insertion.

```
0000   31   00   04   BEG LXI SP, 0400H
0003   21   0E   02     LX1 H, SHOW
0006   E5              PUSH H
0007   21   9A   10     LX1 H, 4250D
000A   E5              PUSH H
000B   C3   D2   DD     JMP 0DD02H
000E   2F              SHOW CMA
000F   D3   FF          OUT OFFH
0011   C3   00   00     JMP BEG
```

To certify we set the stack, push the Return if Error address, push the byte count required to nearly fill a 5 foot wafer, jump to the Certify routine in EPROM, display results on the programmed output port, and return to start to run the test, again.

Table 1.



Controller card for Stringy Floppy.

device addressed to the D000H block as the controller is assigned to this block and may conflict with other devices if similarly addressed.

After turning your computer on, you must enter a short "Certify" program, as shown in Table 1. This will allow certification of your wafers, a process that is necessary with all new wafers. Because the wafers are the endless-loop type, several complete passes may be necessary to distribute the tape lubricant before accurate results can be obtained.

Certifying runs the tape in and checks the reliability at the same time. Any errors detected will normally be displayed on the front panel according to the chart in Table 2. (In my system the error is taken from the "A" register and output to a port to be displayed on the CRT. No display = no errors.)

Successfully certifying a wafer means you have simultaneously tested the transport and controller printed circuit board. Writing a wafer with data is the next test.

The software contains three "Quick Store" routines designed to write 1, 4 and 8K blocks that start storing data from 0000H upward. The procedure is to select a wafer of the appropriate length, five feet for 1 or 4K, ten feet or longer for 8K, insert it into the transport and execute the address shown in Table 3.

The transport will start up and start looking for the end-of-tape/beginning-of-tape marker. Upon detection, it will check to see if the write-protect decal is in place. If it is not there, the procedure is aborted with an appropriate error code displayed. Otherwise, the Write LED will come on indicating the storage of data. Upon completion, control will return to 0000H.

Similar "Quick Load" programs are available to complement the "Quick Store" routines. It is only necessary to insert a wafer with a "Quick Stored" program in the transport and execute the appropriate address in Table 4 according to the recorded block length.

With a successfull write/record test the unit has completed its checkout. It is now ready for use.

Software

The software contains many other routines too numerous to explain in detail at this time, but they are listed in Table 5. In general, the ESF software allows the reading and writing of data in a length to 40K with user defined "User's Return with Error Address," "Control Transfer Address" (possible Auto-Start or Load'N Go), Block Length with Begin and End Addresses and File Number routines to aid in location of a particular file among many on a wafer.

There are also routines to "Verify" a wafer against memory, "Add" a file to a wafer, "Write and Verify," "Add and Verify" and "Park," that is, move the tape in the wafer to a point where the end-of-tape decal is placed in the opening to protect the magnetic portion from accidental harm.

But how does the Stringy Floppy really perform? Just fine thanks! That is not to say it is perfect, just that it operated the first time, is still working and gives me a certain feeling of confidence about further operation. It is certainly not of the type of quality normally expected of the hobbyist market. It is of the best "commercial" quality in terms of material, assembly and software.

The minor problems include not being able to consistently get 50-foot tapes to run on my unit and documentation that, although may be a cut above the competition, is still somewhat incomplete. This latter problem is being corrected by the ESF Newsletter. Exatron has been most helpful in attempting to solve my tape problem, and I am sure we will resolve it soon. Other users have not made mention of any tape problems, so this may be a one of a kind.

Conclusion

For those who need an alternative to a relatively slow, manually operated cassette system and who cannot afford the time and money for a floppy disk the Stringy Floppy is the only way to go. The price is right, the quality is high, and the system works with little or no effort, which, I think, is the key. Hard to believe from a hobbyist computer company, but true. Very true. ■

EXATRON
3555 Ryder Street
Santa Clara CA 95051

Error Code	Programmed Output	ASCII Character	Complement In A-Register
NO MORE TAPE	21 Hex	!	DE Hex
WRITE-PROTECTED	23 Hex	#	DC Hex
NO FILE NUMBER	25 Hex	%	DA Hex
MANY PARITY ERRORS	26 Hex	&	D9 Hex

Table 2.

LABEL	ADDRESS	FROM	TO	FILE#
STOR1	DF2D	0000H	3F0H	FFF1
STOR4	DF39	0000H	0FF0H	FFF4
STOR8	DF45	0000H	1FF0H	FFF8

Table 3. Quick Store routines.

LABEL	ADDRESS	FROM	TO	EXECUTE STARTS
LOAD1	DF07	0000	03F0H	0000H
LOAD4	DF10	0000	0FF0H	0000H
LOAD8	DF19	0000	1FF0H	0000H

Table 4. Quick Load routines.

CERTIFY	Certify a wafer
WRITE	Write a file
READ	Read a file
VERIFY	Verify a file against memory
ADD	Add a file to a wafer in addition to the current file already recorded
WRITE & VERIFY	Write a file and verify
ADD & VERIFY	Add a file to the wafer and verify
PARK	Park the wafer in a protected position

Table 5. General-purpose utility procedures.

Exatron
Stringy Floppy Update

Since the article by Bill Harvey was written, Exatron has developed a TRS-80 version of the Stringy Floppy, with PET and Apple versions soon to be released. The main difference between the S-100 version and the newer TRS-80 version is in ease of operation—the TRS-80 model just plugs into the keyboard and wall socket. Both data and programs can be stored on the unit, up to ten programs or sets of data per wafer.

The cost of the TRS-80 version is $249.50 plus shipping. We now have one of the units in our microlab and will publish a complete user report in the near future. From our experience with the stringy floppy so far, it looks like the ideal compromise between cassette and disk for the microcomputer user—it's inexpensive and fast.

Jim Perry
Microcomputing
Projects Editor



"Actually, it's a tridirectional printer. It prints left/right, right/left and wherever it wants."

We're looking for names and addresses of ***TRS-80 newsletters.*** If you produce or are affiliated with such a newsletter, please drop a line to:

Bob LaPointe, Circulation Manager
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Peterborough NH 03458

Thanks.

See and Copy Tape Data



use TRcopy
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With the TRcopy system you can copy any TRS-80 Level II cassette tape whether it is coded in Basic or in machine language. You can also copy data created by programs and you can copy assembler listings.

YOU CAN SEE THE DATA

As the tape is being loaded, you can SEE the actual data byte-for-byte from the beginning to the end of the program. Up to 320 bytes are displayed at one time. ASCII characters are displayed on the first line and hexadecimal code is displayed on the following two lines. Data is displayed exactly as it is input including memory locations and check sums.

IDENTIFY PROGRAMS

With TRcopy you can identify programs on cassette tapes without written documentation because you can SEE the filename. If you forget to label a tape, you can use TRcopy to display the tape contents and identify the cassette.

VERIFY CASSETTE TAPES

With TRcopy you can verify both the original tape and the tape copies. You can make certain that your machine reads the original tape correctly and that it makes byte-for-byte copies. TRcopy also counts as it reads giving you the exact length of the data.

MAKE BACKUPS FOR YOUR PROGRAMS

Now you can make backup copies of your valuable programs. Many times a cassette that you make will load better than one that is mass produced. The original can then be kept as a backup in case the copy is damaged.

MAKE COPIES OF YOUR SOFTWARE

If you are in the software business you can use TRcopy to make tested copies of your programs for sales distribution. TRcopy produces machine language tapes that are more efficient than those produced by the assembler itself.

RECOVER FAULTY DATA

With TRcopy you can experiment with the volume and level controls and you can SEE what the computer is reading--even if your computer will not read the data through normal read instructions! In this way it is possible to read and copy faulty tapes by adjusting the volume control until you SEE that the data is input properly.

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Steve Tabler
1573 South Sherman Street
Denver CO 80210

Calendar Program

You say pinup calendars are passé? Polish up your pin-outs and program the years ahead.

This calendar program was written in Southwest Technical Products 8K BASIC version 2.3. The system used was the SWTP M6800/2. It had 12K of static RAM memory. A video terminal and Kansas City Standard cassette interface shared port 1, and a 72-column printer was located at port 7 at the time I wrote the program. ■

```
--------------------FEBRUARY--------------------
 S     M     T     W     T     F     S
                         1     2     3
 4     5     6     7     8     9     10
 11    12    13    14    15    16    17
 18    19    20    21    22    23    24
 25    26    27    28
--------------------MARCH---------------------
 S     M     T     W     T     F     S
                         1     2     3
 4     5     6     7     8     9     10
 11    12    13    14    15    16    17
 18    19    20    21    22    23    24
 25    26    27    28    29    30    31
---------------------APRIL---------------------
 S     M     T     W     T     F     S
 1     2     3     4     5     6     7
 8     9     10    11    12    13    14
 15    16    17    18    19    20    21
 22    23    24    25    26    27    28
 29    30
----------------------MAY----------------------
 S     M     T     W     T     F     S
             1     2     3     4     5
 6     7     8     9     10    11    12
 13    14    15    16    17    18    19
 20    21    22    23    24    25    26
 27    28    29    30    31
----------------------JUNE---------------------
 S     M     T     W     T     F     S
                               1     2
 3     4     5     6     7     8     9
 10    11    12    13    14    15    16
 17    18    19    20    21    22    23
 24    25    26    27    28    29    30
```

Sample run.

```
0001 REM CALENDAR PROGRAM WRITTEN IN SWTPC 8K BASIC VERSION 2.3
0002 REM WRITTEN BY STEVE TABLER JULY 24, 1978
0003 REM WILL RUN IN 12K MEMORY SYSTEM.          .
0004 REM PROGRAM DOES SINGLE MONTH OR FULL YEAR .
0005 REM INSTRUCTIONS APPEAR ON CONTROL TERMINAL.
0006 REM LINE 8000 SETS WIDTH OF CALENDAR, PORT NUMBER OF PRINTER, COLUMNS
0007 REM PRINTER HAS AVAILABLE.
0008 REM CHANGE THE 28 IN LINE 8010 TO 29 FOR LEAP YEARS.
0009 REM PROGRAM SETS PRINTER TO PORT 7 UNLESS MODIFIED.
0010 DIM A(12),R$(12),B$(7)
0015 X=1
0020 PRINT "IS THIS A FULL YEAR";:INPUT Y$
0030 IF LEFT$(Y$,1)="Y" THEN X=13:M=1
0035 IF X=13 THEN 50
0040 GOSUB 800
0050 PRINT "WHAT DAY DOES THE MONTH/YEAR START?"
0051 PRINT "(TYPE NUMBER)"
0060 PRINT "1-SUNDAY"
0070 PRINT "2-MONDAY"
0080 PRINT "3-TUESDAY"
0090 PRINT "4-WEDNESDAY"
0100 PRINT "5-THURSDAY"
0110 PRINT "6-FRIDAY"
0120 PRINT "7-SATURDAY"
0130 INPUT D
0140 READ W,P,Z
0145 LINE=Z
0150 C=W/8
0160 FOR I=1 TO 12: READ A(I):NEXT I
0170 FOR C2=1 TO X
0180 FOR S=1 TO 12:READ R$(S):NEXT S
0190 PRINT#P,TAB(3);
0199 LET T2=W/2-9
0200 FOR J=1 TO 3+T2:PRINT#P,"-";:NEXT J
0210 PRINT#P,R$(M);
0220 FOR J=1 TO 3+T2:PRINT#P,"-";:NEXT J
0225 PRINT#P:PRINT#P
0230 FOR S=1 TO 7:READ B$(S):NEXT S
0240 FOR U=1 TO 7
0245 PRINT#P,TAB(U*C);B$(U);
0250 NEXT U
0255 PRINT#P:PRINT#P
0310 FOR U=1 TO 7
0315 PRINT#P,TAB(U*C);
0319 IF C3>0 THEN  325
0320 IF U<D THEN 340
0325 C3=C3+1
0330 PRINT #P,C3;
0335 IF C3=A(M) THEN 600
0340 NEXT U
0345 PRINT #P:PRINT #P
0355 GOTO 310
0360 NEXT C2
0600 IF M=12 THEN 9999
0610 PRINT #P:PRINT #P
0620  M=M+1:C3=0:D=U+1
0630 RESTORE
0635 IF D=8 THEN D=1
0640 IF X=13 THEN 140
0650 STOP
0800 PRINT "WHICH MONTH":PRINT"(TYPE NUMBER)"
0810 PRINT "1-JANUARY"
0820 PRINT "2-FEBRUARY"
0830 PRINT "3-MARCH"
0840 PRINT "4-APRIL"
0850 PRINT "5-MAY"
0860 PRINT "6-JUNE"
0870 PRINT "7-JULY"
0880 PRINT "8-AUGUST"
0890 PRINT "9-SEPTEMBER"
0900 PRINT "10-OCTOBER"
0910 PRINT "11-NOVEMBER"
0920 PRINT "12-DECEMBER"
0930 INPUT M
0940 RETURN
8000 DATA 50,7,120
8010 DATA 31,28,31,30,31,30,31,31,30,31,30,31
8040 DATA -JANUARY-,-FEBRUARY,--MARCH--,--APRIL--,---MAY---,---JUNE--
8050 DATA ---JULY--,--AUGUST-,SEPTEMBER,-OCTOBER-
8055 DATA -NOVEMBER,-DECEMBER
8060 DATA S,M,T,W,T,F,S
9999 END
```

Program listing.

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Four More Commands for SSB DOS

BFD-68 disk users can easily add CLEAR, MOVE, LOCATE and DUMP to their repertoire.

Terry Perdue
1470 Wilson Road
St. Joseph MI 49085

I have been using Smoke Signal Broadcasting's popular BFD-68 disk system with my SWTP computer for several months now and don't know how I ever got along without it. The commands furnished with the operating system allow a great deal of flexibility, and the additional commands available on their users' group library disk, UGLY 0, make the system a pleasure to use.

Presented here are four additional commands that I have found helpful. The operations they perform are associated with the contents of RAM. They execute quickly and print an error message if the command is improperly formatted.

```
&DUMP E7 135

     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
-------------------------------------------------------
00E0                          7F 80 01 FE 07 00 FF 80 00
00F0  FE 06 FE 08 FF 06 FE A6 00 4D 27 A6 85 80 27 06
0100  85 40 27 20 20 19 81 7F 27 1F B7 07 06 FE 07 03
0110  5C B6 07 06 09 27 D0 4A 26 FA F7 80 00 20 F1 BD
0120  04 5D 20 C3 BD 02 27 20 C7 7F 80 01 CE 00 04 FF
0130  80 00 20 D9 81 1B

&CLEAR,102,10C

&DUMP E7,135

     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
-------------------------------------------------------
00E0                          7F 80 01 FE 07 00 FF 80 00
00F0  FE 06 FE 08 FF 06 FE A6 00 4D 27 A6 85 80 27 06
0100  85 40 00 00 00 00 00 00 00 00 00 00 00 FE 07 03
0110  5C B6 07 06 09 27 D0 4A 26 FA F7 80 00 20 F1 BD
0120  04 5D 20 C3 BD 02 27 20 C7 7F 80 01 CE 00 04 FF
0130  80 00 20 D9 81 1B

&MOVE 130 135 105

&DUMP E7 135

     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
-------------------------------------------------------
00E0                          7F 80 01 FE 07 00 FF 80 00
00F0  FE 06 FE 08 FF 06 FE A6 00 4D 27 A6 85 80 27 06
0100  85 40 00 00 00 80 00 20 D9 81 1B 00 00 FE 07 03
0110  5C B6 07 06 09 27 D0 4A 26 FA F7 80 00 20 F1 BD
0120  04 5D 20 C3 BD 02 27 20 C7 7F 80 01 CE 00 04 FF
0130  80 00 20 D9 81 1B

&LOCATE 8000 E7 135

FOUND AT:

00EE, 0105, 011B, 0130

&
```

Example 1.

The Commands

The CLEAR command clears the specified block of memory.

The MOVE command will move intact the contents of the specified block of memory anywhere else in memory. An entire 28K can be moved almost instantaneously. The routine checks the direction of the move to determine from which end of the block the move should be made to avoid errors when the address ranges overlap.

The LOCATE command will search the specified block of memory for any hex string of characters, from one to over 50 bytes in length, and print each address where the string exists. If the string does not exist within that range, "NOT FOUND" will be printed.

The DUMP command outputs the contents of the specified block of memory in a 16-bytes-per-line format. Each line begins with the address of the first position on that line, which is always an integral multiple of 16. This allows the columns to be headed for easier reading.

Consult the listings for the proper format of each command, noting that <SA> is the starting address, <EA> is the ending address (inclusive) and <DA> is the destination address. Example 1 illustrates the results obtained.

These routines have been assembled assuming the DOS is located at $7000. If yours is at $D000, all program references to $7000 block addresses will need to be changed to reference the corresponding addresses in the $D000 block.

Note: Since these commands occupy the transient program area (TPA), which exists within the monitor, the SAVE.BLD program furnished with the DOS must be loaded (using the resident GET command) before SAVEing the file. If you fail to do this or if you use any other transient command, such as LIST, after keying in the program and before SAVEing it, you will wipe out the program you intended to save. See the manual for details.

I hope you will find that these commands add to the utility of your disk system. ■

Listing 1. CLEAR command.

```
00010                    NAM    CLEAR.$
00030               * COMMAND FORMAT:  &CLEAR,<SA>,<EA>
00050               * WRITTEN BY TERRY PERDUE  7-78
00070                    OPT    O
00090     7080   TPA     EQU    $7080
00100     7283   ZWARMS  EQU    $7283
00110     729D   ZDIE    EQU    $729D
00120     72A0   ZGETHN  EQU    $72A0
00140 7080               ORG    TPA
```

```
00160 7080 BD 72A0        JSR    ZGETHN   GET START ADR.
00170 7083 25 3B          BCS    ADRERR   NON HEX
00180 7085 5D             TST B
00190 7086 27 38          BEQ    ADRERR   NO ST. ADR.
00200 7088 FF 70D4        STX    START    SAVE ST. ADR.
00210 708B BD 72A0        JSR    ZGETHN   GET END ADR.
00220 708E 25 30          BCS    ADRERR   NON HEX
00230 7090 5D             TST B
00240 7091 27 2D          BEQ    ADRERR   NO END ADR.
00250 7093 FF 70D6        STX    END      SAVE END ADR.
00260 7096 F6 70D7        LDA B  END+1
00270 7099 F0 70D5        SUB B  START+1
00280 709C F6 70D6        LDA B  END
00290 709F F2 70D4        SBC B  START
00300 70A2 2B 1C          BMI    ADRERR   <SA> > <EA>
00310 70A4 FE 70D6        LDX    END      ADD ONE
00320 70A7 08             INX             TO
00330 70A8 FF 70D6        STX    END      END ADR.
00340 70AB 81 0D          CMP A  #$D      LAST DELIM. A CR.?
00350 70AD 26 11          BNE    ADRERR
00360 70AF FE 70D4        LDX    START
00370 70B2 4F             CLR A
00380 70B3 BC 70D6 ZERO   CPX    END      LAST ADR.?
00390 70B6 27 05          BEQ    DONE
00400 70B8 A7 00          STA A  X        CLR IT
00410 70BA 08             INX             POINT TO NEXT ADR.
00420 70BB 20 F6          BRA    ZERO     GO CLEAR IT
00430 70BD 7E 7283 DONE   JMP    ZWARMS
00440 70C0 CE 70C6 ADRERR LDX    #ERRMSG
00450 70C3 7E 729D        JMP    ZDIE

00470 70C6 41      ERRMSG FCC    'ADDRESS ERROR'
      70C7 44
      70C8 44
      70C9 52
      70CA 45
      70CB 53
      70CC 53
      70CD 20
      70CE 45
      70CF 52
      70D0 52
      70D1 4F
      70D2 52
00480 70D3 00             FCB    0

00500 70D4 0002   START  RMB    2
00510 70D6 0002   END    RMB    2

00530                    END
```

Listing 2. MOVE command.

```
00010                    NAM    MOVE.$

00030             * COMMAND FORMAT:
00040             *        &MOVE,<SA>,<EA>,<DA>

00060             * WRITTEN BY TERRY PERDUE  7-78

00080                    OPT    O

00100      7080  TPA    EQU    $7080
00110      7283  ZWARMS EQU    $7283
00120      729D  ZDIE   EQU    $729D
00130      72A0  ZGETHN EQU    $72A0

00150 7080               ORG    TPA

00170 7080 8D 7B          BSR    GETADR   GET START ADR.
00180 7082 FF 713A        STX    START    SAVE IT
00190 7085 8D 76          BSR    GETADR   GET END ADR.
00200 7087 FF 713C        STX    END      SAVE IT
00210 708A 8D 71          BSR    GETADR   GET DESTINATION ADR.
00220 708C FF 713E        STX    DESTIN   SAVE IT
00230 708F 81 0D          CMP A  #$D      LAST DELIM. A CR.?
00240 7091 26 73          BNE    PERROR
00250 7093 B6 713D        LDA A  END+1    GET DIFFERENCE
00260 7096 B0 713B        SUB A  START+1  BETWEEN
00270 7099 B7 7141        STA A  NUMBER+1 END ADR.
00280 709C B6 713C        LDA A  END      AND START
00290 709F B2 713A        SBC A  START    ADR.
00300 70A2 2B 62          BMI    PERROR   <SA> > <EA>
00310 70A4 B7 7140        STA A  NUMBER   ADD ONE
00320 70A7 FE 7140        LDX    NUMBER   TO GET
00330 70AA 08             INX             LENGTH
00340 70AB FF 7140        STX    NUMBER   OF BLOCK
00350 70AE B6 713B        LDA A  START+1  FIND OUT
00360 70B1 B0 713F        SUB A  DESTIN+1 WHICH
00370 70B4 B7 7143        STA A  XTEMP+1  WAY TO
00380 70B7 B6 713A        LDA A  START    MOVE BLOCK -
00390 70BA B2 713E        SBC A  DESTIN   DETERMINES
00400 70BD B7 7142        STA A  XTEMP    WHICH END
00410 70C0 FE 7142        LDX    XTEMP    TO WORK FROM
00420 70C3 27 64          BEQ    DONE     NO MOVE REQ'D
00430 70C5 2A 45          BPL    MOVEDN   MOVE DOWN OR -
00440 70C7 B6 7141        LDA A  NUMBER+1 UP:
00450 70CA BB 713F        ADD A  DESTIN+1 GET
00460 70CD B7 713F        STA A  DESTIN+1 HIGHEST
00470 70D0 B6 7140        LDA A  NUMBER   ADDRESS
00480 70D3 B9 713E        ADC A  DESTIN   OF
00490 70D6 B7 713E        STA A  DESTIN   DESTINATION
00500 70D9 FE 713E        LDX    DESTIN   AND
00510 70DC 09             DEX             START
00520 70DD FF 713E        STX    DESTIN   THERE
00530 70E0 FE 713C MOVEUP LDX    END      POINT TO BYTE
00540 70E3 A6 00          LDA A  X        GET IT
00550 70E5 09             DEX             DEC. 'FROM' POINTER
00560 70E6 FF 713C        STX    END      SAVE IT
00570 70E9 FE 713E        LDX    DESTIN   GET DESTINATION
00580 70EC A7 00          STA A  X        PUT BYTE THERE
00590 70EE 09             DEX             DEC. 'TO' POINTER
00600 70EF FF 713E        STX    DESTIN   SAVE IT
00610 70F2 FE 7140        LDX    NUMBER   DEC. THE
00620 70F5 09             DEX             BYTE COUNTER
00630 70F6 27 31          BEQ    DONE     IF ZERO, DONE
00640 70F8 FF 7140        STX    NUMBER   SAVE IT
00650 70FB 20 E3          BRA    MOVEUP   GO DO AGAIN
00660 70FD BD 72A0 GETADR JSR    ZGETHN   GET AN ADR. FROM IN. BUFFER
00670 7100 25 04          BCS    PERROR   NON HEX
00680 7102 5D             TST B
00690 7103 27 01          BEQ    PERROR   NO ADR.
00700 7105 39             RTS             RETURN
00710 7106 CE 712C PERROR LDX    #ERROR
00720 7109 7E 729D        JMP    ZDIE
00730 710C FE 713A MOVEDN LDX    START    POINT TO BYTE
00740 710F A6 00          LDA A  X        GET IT
00750 7111 08             INX             INC. 'FROM  POINTER
00760 7112 FF 713A        STX    START    SAVE IT
00770 7115 FE 713E        LDX    DESTIN   GET DESTINATION
00780 7118 A7 00          STA A  X        PUT BYTE THERE
00790 711A 08             INX             INC. 'TO' POINTER
00800 711B FF 713E        STX    DESTIN   SAVE IT
00810 711E FE 7140        LDX    NUMBER   DEC. THE
00820 7121 09             DEX             BYTE COUNTER
00830 7122 27 05          BEQ    DONE     IF ZERO, DONE
00840 7124 FF 7140        STX    NUMBER   SAVE IT
00850 7127 20 E3          BRA    MOVEDN   GO DO AGAIN
00860 7129 7E 7283 DONE   JMP    ZWARMS

00880 712C 41      ERROR  FCC    'ADDRESS ERROR'
      712D 44
      712E 44
      712F 52
      7130 45
      7131 53
      7132 53
      7133 20
      7134 45
      7135 52
      7136 52
      7137 4F
      7138 52
00890 7139 00             FCB    0

00910 713A 0002   START  RMB    2
00920 713C 0002   END    RMB    2
00930 713E 0002   DESTIN RMB    2
00940 7140 0002   NUMBER RMB    2
00950 7142 0002   XTEMP  RMB    2

00970                    END
```

Listing 3. LOCATE command.

```
00010                    NAM    LOCATE.$

00030             * COMMAND FORMAT:
00040             *        &LOCATE,<HEX STRING>,<SA>,<EA>

00060             * WRITTEN BY TERRY PERDUE  7-78

00080                    OPT    O

00100      7080  TPA    EQU    $7080
00110      7283  ZWARMS EQU    $7283
00120      7286  OUTEEE EQU    $7286
00130      7297  ZGNCHR EQU    $7297
00140      729D  ZDIE   EQU    $729D
00150      72A0  ZGETHN EQU    $72A0
00160      72A6  ZOUTST EQU    $72A6
00170      72AF  ZOUTHA EQU    $72AF
00180      72FC  BUFPTR EQU    $72FC

00200 7080               ORG    TPA

00220 7080 FE 72FC        LDX    BUFPTR   GET ADR. OF DELIM. PREC. STRI
00230 7083 FF 71A9        STX    STGBEG   SAVE IT
00240 7086 BD 72A0        JSR    ZGETHN   FIND NEXT DELIM.
00250 7089 24 03          BCC    *+5
00260 708B 7E 7110        JMP    STGERR   NON HEX CHAR. IN STRING
00270 708E 5D             TST B
00280 708F 27 7F          BEQ    STGERR   NO HEX CHAR. IN STRING
00290 7091 FE 72FC        LDX    BUFPTR   GET ADR. OF DELIM. FOLL. STRI
```

```
00300 7094 FF 71AB        STX    STGEND   SAVE IT
00310 7097 BD 72A0        JSR    ZGETHN   GET START ADR.
00320 709A 25 7A          BCS    ADRERR   NON HEX
00330 709C 5D             TST B
00340 709D 27 77          BEQ    ADRERR   NO SR. ADR.
00350 709F FF 71B2        STX    START    SAVE ST. ADR.
00360 70A2 09             DEX
00370 70A3 FF 71AF        STX    MPTR1    START LOC. MINUS ONE
00380 70A6 BD 72A0        JSR    ZGETHN   GET END ADR.
00390 70A9 25 6B          BCS    ADRERR   NON HEX
00400 70AB 5D             TST B
00410 70AC 27 68          BEQ    ADRERR   NO END ADR.
00420 70AE FF 71B4        STX    END      SAVE END ADR.
00430 70B1 F6 71B3        LDA B  START+1
00440 70B4 F0 71B5        SUB B  END+1
00450 70B7 F6 71B2        LDA B  START
00460 70BA F2 71B4        SBC B  END
00470 70BD 2A 57          BPL    ADRERR   <SA> MUST BE < <EA>
00480 70BF FE 71B4        LDX    END      ADD ONE
00490 70C2 08             INX             TO
00500 70C3 FF 71B4        STX    END      END ADR.
00510 70C6 81 0D          CMP A  #$D      FINAL DELIM. A CR?
00520 70C8 26 4C          BNE    ADRERR   NO
00530 70CA FE 71A9 TRYAGN LDX    STGBEG   ADR. OF DELIM. PREC. STRING
00540 70CD FF 72FC        STX    BUFPTR   POINT TO IT
00550 70D0 FE 71AF        LDX    MPTR1    ADVANCE POINTER
00560 70D3 08             INX             AND START
00570 70D4 FF 71AF        STX    MPTR1    COMPARING
00580 70D7 FF 71AD CONTIN STX    MEMPTR   CONTINUE MATCHING
00590 70DA E6 00          LDA B  X        GET CHAR. FROM MEMORY
00600 70DC F7 71B1        STA B  TEMP
00610 70DF BD 7297        JSR    ZGNCHR   MS NIB. OF ASCII CHAR. FROM S
00620 70E2 FE 72FC        LDX    BUFPTR   HAS LAST CHAR. FROM STRING
00630 70E5 BC 71AB        CPX    STGEND   BEEN MATCHED?
00640 70E8 27 3B          BEQ    FOUND    SUCCESS!
00650 70EA 8D 30          BSR    ASCTHX   CONVERT IT TO HEX
00660 70EC 48             ASL A
00670 70ED 48             ASL A
00680 70EE 48             ASL A
00690 70EF 48             ASL A
00700 70F0 16             TAB
00710 70F1 BD 7297        JSR    ZGNCHR   LS NIBBLE
00720 70F4 FE 72FC        LDX    BUFPTR
00730 70F7 BC 71AB        CPX    STGEND
00740 70FA 27 14          BEQ    STGERR   STRING CONTAINED A HALF-BYTE
00750 70FC 8D 1E          BSR    ASCTHX   CONVERT TO HEX
00760 70FE 1B             ABA             PACK TO FORM HEX BYTE
00770 70FF F6 71B1        LDA B  TEMP     CHAR. FROM MEMORY
00780 7102 FE 71AD MATCHK LDX    MEMPTR   ADVANCE AS LONG AS
00790 7105 BC 71B4        CPX    END      MATCHES OCCUR UNLESS
00800 7108 27 4E          BEQ    DONE     REACH LAST ADR. WITHOUT
00810 710A 08             INX             COMPLETE MATCH
00820 710B 11             CBA             COMPARE BYTES
00830 710C 26 BC          BNE    TRYAGN   NO MATCH
00840 710E 20 C7          BRA    CONTIN   MATCHED - CHECK NEXT BYTE
00850 7110 CE 7176 STGERR LDX    #PSTERR
00860 7113 7E 729D        JMP    ZDIE
00870 7116 CE 7185 ADRERR LDX    #PADERR
00880 7119 7E 729D        JMP    ZDIE
00890 711C 80 30   ASCTHX SUB A  #$30    CONVERT
00900 711E 81 09          CMP A  #9       ASCII CHAR.
00910 7120 2F 02          BLE    RETURN   IN STRING
00920 7122 80 07          SUB A  #7       TO HEX
00930 7124 39      RETURN RTS
00940 7125 B6 71A8 FOUND  LDA A  FOUND1   IF FIRST FIND,
00950 7128 27 20          BEQ    OUTFND   OUTPUT 'FOUND AT:'
00960 712A 81 0A          CMP A  #$A      IF TEN ADR. ON LINE,
00970 712C 27 0C          BEQ    NULINE   START NEW LINE
00980 712E 86 2C          LDA A  #',      ELSE PRINT A COMMA,
00990 7130 BD 7286        JSR    OUTEEE
01000 7133 86 20          LDA A  #$20     AND A SPACE,
01010 7135 BD 7286        JSR    OUTEEE
01020 7138 20 05          BRA    OUTADR   THEN NEXT ADR.
01030 713A 7F 71A8 NULINE CLR    FOUND1
01040 713D 8D 2C          BSR    CRLF
01050 713F 7C 71A8 OUTADR INC    FOUND1   COUNT ADR.S PER LINE
01060 7142 CE 71AF        LDX    #MPTR1   POINT TO ADR.
01070 7145 BD 72AF        JSR    ZOUTHA   OUTPUT IT
01080 7148 20 80          BRA    TRYAGN   LOOK FOR MORE OF SAME STRING
01090 714A 8D 1F   OUTFND BSR    CRLF
01100 714C CE 7193        LDX    #FNDMSG  'FOUND AT:'
01110 714F BD 72A6        JSR    ZOUTST
01120 7152 8D 17          BSR    CRLF
01130 7154 8D 15          BSR    CRLF
01140 7156 20 E7          BRA    OUTADR
01150 7158 8D 11   DONE   BSR    CRLF
01160 715A 7D 71A8        TST    FOUND1
01170 715D 27 03          BEQ    NOFIND   STRING NEVER FOUND
01180 715F 7E 7283        JMP    ZWARMS
01190 7162 CE 719D NOFIND LDX    #NFMSG   'NOT FOUND'
01200 7165 BD 72A6        JSR    ZOUTST
01210 7168 7E 7283        JMP    ZWARMS
01220 716B 86 0D   CRLF   LDA A  #$D
01230 716D BD 7286        JSR    OUTEEE
01240 7170 86 0A          LDA A  #$A
01250 7172 BD 7286        JSR    OUTEEE
01260 7175 39             RTS

01280 7176 49      PSTERR FCC    'INVALID STRING'
      7177 4E
      7178 56
      7179 41
      717A 4C
      717B 49
      717C 44
      717D 20
      717E 53
      717F 54
      7180 52
      7181 49
      7182 4E
      7183 47
01290 7184 00             FCB    0
01300 7185 41      PADERR FCC    'ADDRESS ERROR'
      7186 44
      7187 44
      7188 52
      7189 45
      718A 53
      718B 53
      718C 20
      718D 45
      718E 52
      718F 52
      7190 4F
      7191 52
01310 7192 00             FCB    0
01320 7193 46      FNDMSG FCC    'FOUND AT:'
      7194 4F
      7195 55
      7196 4E
      7197 44
      7198 20
      7199 41
      719A 54
      719B 3A
01330 719C 00             FCB    0
01340 719D 4E      NFMSG  FCC    'NOT FOUND'
      719E 4F
      719F 54
      71A0 20
      71A1 46
      71A2 4F
      71A3 55
      71A4 4E
      71A5 44
01350 71A6 0A00           FDB    $0A00

01370 71A8 00      FOUND1 FCB    0
01380 71A9 0002    STGBEG RMB    2
01390 71AB 0002    STGEND RMB    2
01400 71AD 0002    MEMPTR RMB    2
01410 71AF 0002    MPTR1  RMB    2
01420 71B1 0001    TEMP   RMB    1
01430 71B2 0002    START  RMB    2
01440 71B4 0002    END    RMB    2

01460                     END
```

Listing 4. DUMP command.

```
00010                     NAM    DUMP.$

00030               * COMMAND FORMAT:  $DUMP,<SA>,<EA>

00050               * WRITTEN BY TERRY PERDUE  7-78

00070                     OPT    O

00090      7080   TPA    EQU    $7080
00100      7283   ZWARMS EQU    $7283
00110      7286   OUTEEE EQU    $7286
00120      729D   ZDIE   EQU    $729D
00130      72A0   ZGETHN EQU    $72A0
00140      72AC   ZOUTHX EQU    $72AC
00150      72AF   ZOUTHA EQU    $72AF

00170 7080                ORG    TPA

00190 7080 BD 72A0        JSR    ZGETHN   GET START ADR.
00200 7083 25 7A          BCS    PERROR   NON HEX
00210 7085 5D             TST B
00220 7086 27 77          BEQ    PERROR   NO START ADR.
00230 7088 FF 7158        STX    MEMPTR   SAV ST. ADR.
00240 708B BD 72A0        JSR    ZGETHN   GET END ADR.
00250 708E 25 6F          BCS    PERROR   NON HEX
00260 7090 5D             TST B
00270 7091 27 6C          BEQ    PERROR   NO END ADR.
00280 7093 FF 715A        STX    END      SAVE END ADR.
00290 7096 F6 715B        LDA B  END+1
00300 7099 F0 7159        SUB B  MEMPTR+1
00310 709C F6 715A        LDA B  END
00320 709F F2 7158        SBC B  MEMPTR
00330 70A2 2B 5B          BMI    PERROR   <SA> > <EA>
00340 70A4 FE 715A        LDX    END      ADD ONE
00350 70A7 08             INX             TO
00360 70A8 FF 715A        STX    END      END ADR.
```

```
00370 70AB 81 0D          CMP A  #$D      LAST DELIM. A CR.?
00380 70AD 26 50          BNE    PERROR
00390 70AF 8D 7D          BSR    CRLF     PRINT HEADING
00400 70B1 8D 70          BSR    OUT2S
00410 70B3 8D 6E          BSR    OUT2S
00420 70B5 C6 30          LDA B  #'0      START WITH 0
00430 70B7 8D 6A   CONTIN BSR    OUT2S    AND PRINT THRU F
00440 70B9 17             TBA
00450 70BA BD 7286        JSR    OUTEEE
00460 70BD C1 39          CMP B  #'9      PRINTED 9 YET?
00470 70BF 26 02          BNE    LETTER
00480 70C1 C6 40          LDA B  #$40     IF SO, NEED A THRU F
00490 70C3 C1 46   LETTER CMP B  #'F
00500 70C5 27 03          BEQ    NXTLIN
00510 70C7 5C             INC B
00520 70C8 20 ED          BRA    CONTIN
00530 70CA 8D 62   NXTLIN BSR    CRLF
00540 70CC C6 35          LDA B  #53      NEXT LINE OF HEADING
00550 70CE 86 2D   DASH   LDA A  #'-      TO BE 53 DASHES
00560 70D0 BD 7286        JSR    OUTEEE
00570 70D3 5A             DEC B           COUNT THEM
00580 70D4 26 F8          BNE    DASH
00590 70D6 8D 56          BSR    CRLF
00600 70D8 B6 7159        LDA A  MEMPTR+1 GET LS BYTE OF ST. ADR.
00610 70DB 36             PSH A           SAVE IT
00620 70DC 16             TAB
00630 70DD C4 F0          AND B  #$F0     MAKE IT -0
00640 70DF F7 7159        STA B  MEMPTR+1 OUTPUT
00650 70E2 8D 55          BSR    OUTADR   THAT ADR.
00660 70E4 32             PUL A
00670 70E5 B7 7159        STA A  MEMPTR+1 RESTORE ADR. POINTER
00680 70E8 10             SBA             DIFFERENCE IS NUMBER
00690 70E9 16             TAB             OF BYTES TO SKIP
00700 70EA 37             PSH B           SAVE FOR LATER
00710 70EB 5D      SKIP   TST B           DONE SKIPPING?
00720 70EC 27 07          BEQ    READY    GO DO YOUR THING
00730 70EE 8D 33          BSR    OUT2S
00740 70F0 8D 36          BSR    OUT1S
00750 70F2 5A             DEC B
00760 70F3 20 F6          BRA    SKIP
00770 70F5 FE 7158 READY  LDX    MEMPTR   GET START ADR.
00780 70F8 33             PUL B           NUMBER OF BYTES SKIPPED
00790 70F9 86 10          LDA A  #$10     FROM TOTAL PER LINE
00800 70FB 10             SBA             GIVES NUMBER LEFT TO PRINT
00810 70FC 16             TAB             IN FIRST LINE
00820 70FD 20 0C          BRA    NEXT     GO START TO OUTPUT LINES
00830 70FF CE 7148 PERROR LDX    #ERROR
00840 7102 BD 729D        JSR    ZDIE
00850 7105 8D 27   NULINE BSR    CRLF     START NEW LINE
00860 7107 8D 30          BSR    OUTADR   WITH ADDRESS
00870 7109 C6 10          LDA B  #$10     NO. OF BYTES PER LINE
00880 710B BD 72AC NEXT   JSR    ZOUTHX   OUTPUT THE BYTE
00890 710E 8D 18          BSR    OUT1S
00900 7110 08             INX
00910 7111 FF 7158        STX    MEMPTR
00920 7114 BC 715A        CPX    END      IF NOT DONE,
00930 7117 27 05          BEQ    DONE
00940 7119 5A             DEC B           DEC. BYTE POINTER
00950 711A 26 EF          BNE    NEXT     AND CONTINUE. IF 16 BYTES,
00960 711C 20 E7          BRA    NULINE   START NEW LINE
00970 711E 8D 0E   DONE   BSR    CRLF
00980 7120 7E 7283        JMP    ZWARMS
00990 7123 86 20   OUT2S  LDA A  #$20
01000 7125 BD 7286        JSR    OUTEEE
01010 7128 86 20   OUT1S  LDA A  #$20
01020 712A BD 7286        JSR    OUTEEE
01030 712D 39             RTS
01040 712E 86 0D   CRLF   LDA A  #$D
01050 7130 BD 7286        JSR    OUTEEE
01060 7133 86 0A          LDA A  #$A
01070 7135 BD 7286        JSR    OUTEEE
01080 7138 39             RTS
01090 7139 FF 7156 OUTADR STX    XSAVE    SAVE X
01100 713C CE 7158        LDX    #MEMPTR  POINT TO LOC. OF ADR.
01110 713F BD 72AF        JSR    ZOUTHA   OUTPUT IT
01120 7142 FE 7156        LDX    XSAVE    RESTORE X
01130 7145 8D DC          BSR    OUT2S
01140 7147 39             RTS

01160 7148 41      ERROR  FCC    'ADDRESS ERROR'
      7149 44
      714A 44
      714B 52
      714C 45
      714D 53
      714E 53
      714F 20
      7150 45
      7151 52
      7152 52
      7153 4F
      7154 52
01170 7155 00             FCB    0

01190 7156 0002    XSAVE  RMB    2
01200 7158 0002    MEMPTR RMB    2
01210 715A 0002    END    RMB    2

01230                     END
```


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For Sale: Heath H11 computer with H11-2 par. int. & 2 H11-1 mem cards. Fully assem. & tested. Asking $1675. Chris Robinson, 1805 Roswell #29M, Marietta GA 30062. (404) 977-1891.

Synertek SYM-I for sale or trade for old/new cameras. Incl. all manuals, 4K RAM, I/O display, reg. pwr. sup.: $195. Call (516) 921-3603 collect anytime.

For Sale—Alpha-Micro Computer—Includes AM-100 16 bit CPU, TEI cabinet & power supply, 64K RAM, 10MB Control Data Hawk Disk Drive, AMOS Operating System, Business software (accounts receivable, general ledger, payroll). C. Hayes 62 South Franklin St., Wilkes-Barre PA 18773, (717) 823-3101.

Canadians—Technico TMS9900 microcomputer with Instant Assember, 2K on-board RAM, RS-232 and TTY interfaces, $375. Video terminal, 16 by 64, upper- and lowercase, heavy power supply will run single board computer. Nice case and keyboard RS-232, $400. Hitachi video monitor, $200. Prime 21L02s—450 ns, $95 for 64. Will also ship to US. Bill Peters, 194 Oakwood Ave., Winnipeg, Manitoba R3B 0N2. (204) 475-4640 evgs.

Reconfiguring my system. Tarbell cassette interface, $90; DG PT96 printer + P/S 120 cps, $350; Mits 8-bit PIO (used with PT96), $50; Portacom terminal + 10 key + modem, $800; Memorex 1280 terminal, $1000; 10-120 cps (impact), print belts, spare parts, documentation, tractor and friction feed. Offers? Trade? (805) 985-1341.

Digital Group SYS-3 Z-80 system. 18K, 4-drive phi-decks, 9" CRT, Maxi-switch keyboard, all in DG cabinets. Phimon & other software. Make offer to J. Angell, 510 Davidson, Apt. 3, Chula Vista CA 92010. (714) 427-7834.

For Sale—MSI 6800 computer with 56K RAM. 2—MSI 8" floppy disks, Beehive 150 terminal, Centronics 779 printer. Software Dynamics BASIC Compiler and SDOS. BASIC 1.4 and DOS, all programs and manuals. Cost $9500, will sell for $6900. Call Ron (215) 297-5946. PO Box 176, Solebury PA 18963.

For Sale: SWTP PR-40 Printer. Good Cond. 3 rolls paper. Went to larger unit. First cashiers check for $150. Firm. Jim Schuster, 2804 Killarney, Cary IL 60013 (312) 639-0294 Eves.

For Sale: TRS-80, Level I, 16K complete system. Keyboard, video display and cassette recorder. Also included are games such as: Invasion Force, Star Pilot, etc. 18 software programs in all. System only 7 months old. Voice synthesizer and manual included. All this only $1211. R. Wiley, 1009 S. Sterling Ave., Tampa FL 33609.

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Tractor-feed 132 column printer—almost new Centronics 700, with service contract! Plugs into TRS-80, incl. service manual & extra ribbons. $1000 or offer. Stand, $85. (213) 997-0882.

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Integral Data Systems IP-225 dot matrix printer with tractor feed, all options and parallel interface cable. Can be rewired simply for serial interface. Never used—in original shipping carton. Paid $1200. Take $950. Hitachi P-05 12" TV with Pickles & Trout TV Mod Kit installed, $85. Call me at (617) 872-3469 or write Dennis Eberl, 153 2nd St., #163, Framingham MA 01701.

For Sale: Centronics Micro Printer, RS-232, electrographic printing, 4.6" wide; 20, 40, 80 ch/line; w/20 rolls of paper, $350 or offer; C. Looney, 3406 Notre Dame St., Hyattsville MD 20783.

REVIEWS

(from page 14)

mathematics or electronics, it leads the reader through binary states, various number systems, Boolean algebra and logic charts.

Then comes the fascinating and useful section: "Manipulating Logic Expressions." If you've ever tried to hook up a TTL circuit from a magazine, for example, and wondered if you could use some NAND gates that you have instead of the 3-input NOR gate specified, this could be a real lifesaver.

My own approach to TTL circuit "design" has been, "If I have a one here and a one there, then there'll be a zero here. Now, let's see, a zero here and a one here. . . ." In a few paragraphs, this course explains how to work it all out with just a few simple but powerful rules.

Electronic logic symbols and devices are dealt with—not extensively, but enough to show you how to apply the theory to "real things," such as switches and AND gates.

At several points in the course, the reader is invited to answer some "home study questions." The questions are the real essence and beauty of the work; they show you just how well you're doing, and they help to hammer the information home. My initial impression was that more examples and explanations should have been included, especially in the application of the DeMorgan Theorem. But when I missed some questions and went back to see *why*, things fell into place.

There's an 8-page "table of equivalent symbols," which is interesting by itself. It shows, for example, about a dozen different ways that AND gates are drawn by various organizations.

This "mini-course" is well written and covers a lot of ground. A word of caution: Don't begin by leafing through the course. I did—and scared myself so badly when I saw things like $A(A+B+C+D+E)=A$ that I put the course away for several weeks. Take it as it comes and it will all make sense.

We are told that "logic is the language of organization." This course will help you to get organized. It may even set you to thinking of alternative ways to skin non-computer-related cats.

The "Logic—Home Study Course" is worth more than its $3 cost. Compliments to author Aronson and to Measurements & Control for a fine job.

Dennis G. Brewer
New York NY

CONTEST!

Winner of the "best article" for July is F. R. Ruckdeschel, author of "IC Logic Tester."

The Book Nook winner is Larry L. DeRosier of Minneapolis MN, and winner of a lifetime subscription is J. D. Lawyer of Dayton OH.

Congratulations, all.

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CORRECTIONS

In "TRSpeed-up" by Scott King (September 1979, p. 38), instruction 6 should read: "connect a wire to pin 12 of Z56" . . . not pin 14, which is the input. Pin 12 is the output of the unused divide-by-2 gate. Hint: If you have a problem with your program crashing when you speed up your TRS-80, try connecting a switch to the WAIT line and triggering the switch directly before you change the speed. (Provided by Jerry Wyatt of Computersystems, Columbia SC.)

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Arena

Be kind to your lionesque computer, and you might later be spared in the "arena."



Franz hefted his two-handed sword and strode without hesitation to the center of the arena. His keen eyes barely had time to register the frenzied, screaming blur that suddenly bore down upon him. Blood gushed from Franz's arm as he hastily parried the rain of blows from his wild-eyed opponent. Could the berserker possibly keep up this furious pace?

No! . . . the wild man paused —it was less than a second, but time enough for a battle-seasoned warrior to strike with a stunning force. Franz wasted no pity on his fallen foe. His next blow opened a mortal wound. Panting, sweating, bleeding, the gladiator raised his clenched fist skyward in the ageless sign of victory . . . and read, "DO YOU WANT TO PLAY AGAIN?"

Arena is a game of mortal combat for two to five players. It was written using Southwest 8K BASIC on a 6800 Gimix Ghost system. The winner of each game is the last person still alive—combat is always "to the death." Each player must use strategy and be ready to take advantage of the opportunities chance provides.

```
* 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 *  FRANZ'S TURN
1                               1
2                               2  YOUR CONDITION IS GOOD (100)
3                               3
4                               4  YOU ARE ATTACKING BORIS
5       F  B                    5  YOU ARE ENGAGED BY BORIS
6                               6
7                               7  FACING:
8                               8  4 3 2 4 3 2
9                               9    \|/ \|/
0                               0  5-F-**-B-1
1                               1    /|\ /|\
* 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 *  6 7 8 6 7 8
```

Fig. 1. Arena display.

Instructions

The Turn. Arena proceeds as a series of turns during which each player is allowed one move. The order of moves within a turn is not fixed and may be influenced by various factors, such as movement and combat on previous turns.

The Move. A player's move consists of the following sequence of events:

1. The player is asked by name to press the return key. This is intended to give him time to chase other players away from the screen so that they don't see his status display.
2. The playing field, the player's status and the facing rosettes are displayed.
3. The player is asked to choose an option from the list presented.
4. The player is allowed to adjust his combat attention percentage.
5. If the attack option was chosen, combat is resolved.

The Display. At the start of a player's move, the screen is filled with a display (see Fig. 1). The left side of this display is the playing field. The right side gives the player's status and a graphic indication of the direction in which each player is facing.

These facing indicators, or rosettes, contain the first letter of a player's name surrounded by the numbers from one to eight. These numbers are used to refer to the eight directions in which a player may be facing. An asterisk overlays the number that indicates a given player's current direction. The first letter of a player's name is

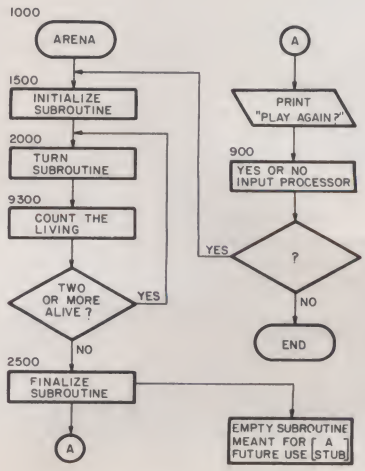


Fig. 2. Program flowchart.

also used to indicate the player's position on the playing field.

Player Status. The player's status consists of his condition expressed in energy units. Each player starts with 100 units. The name of the opponent under attack by the player (if any) and a list of any opponents attacking (engaging) the player are printed below the status line. Notice is also given here of a stunned condition.

Options. The options available to the player on a given turn depend on his status. Possible options are MOVE, TURN, DISENGAGE, ATTACK and STAND. The first three options require that the player's energy units be sufficient to cover the energy costs, but they do not affect the player's status. MOVE costs 15 units per square (X + Y), and a maximum of four squares may be moved. TURN costs five units per facing number. DISENGAGE costs 15 units and may or may not be successful. STAND is a "do nothing" option. ATTACK leads to combat.

To attack an opponent, the player must be adjacent to and facing the opponent. For example, a player who wished to move up one space and left two spaces would require 45 energy units. If he also wished to turn 90 degrees, a total of 55 energy units would be required. But this movement would not diminish the player's number of energy units. Energy units can only be expended in battle.

Combat Attention. The heart of combat strategy in Arena is the combat-attention percentage. This percentage enables the player to divide his attention between attack and defense. For example, a player whose combat attention is 100 percent on attack and 0 percent on defense (a berserker) will be a formidable opponent when attacking, but won't bother much with defense.

Combat. If the player chooses the ATTACK option, his move ends with combat. The results of combat take effect immediately. If the attacker misses or is parried, the defender gets a return swing. A hit results in damage, which permanently lowers the hit player's energy units by an amount that may vary from 1 to 50 units, depending on the severity of the blow. This is the only way that energy units may be lost.

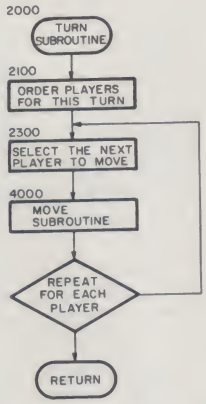


Fig. 3. Turn subroutine flowchart.

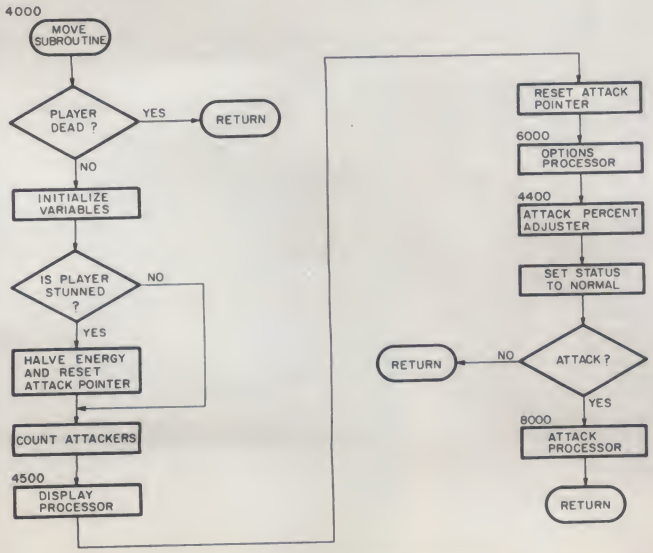


Fig. 4. Move subroutine flowchart.

System Requirements

When I first acquired my Gimix computer, I decided to explore its capabilities by writing a game program. Having worked with computers for over ten years, I decided my initial game effort would be fairly complex in design. I also decided to apply the same design techniques that I would use in a business-programming environment.

The rules of Arena are complex enough to allow for real strategy, but simple enough to be easily learned. The system includes 24K of memory and a Gimix video board; the program uses less than 20K.

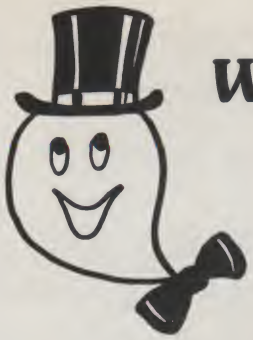
Arena uses character graphics to display a 15 × 11 playing field and a "facing rosette" for each player. To solve the problem of BASIC's almost nonexistent output formatting, I used POKEs to place the players on the field and the directional markers in the rosettes (see POKE PLAYERS subroutine, lines 5900 to 5950). This technique requires some form of memory-mapped display.

Constant B is set to the start of my video board's display memory. It should be fairly easy to modify the POKE PLAYERS subroutine to work with a video

Program listing.

```
0100 REM *** ARENA - BY RICHARD PRICE ***
0110 REM ***
0200 REM BANNER
0210 PRINT CHR$(12);"                    ARENA VERSION 2.0"
0220 PRINT
0230 PRINT "     A GAME OF MORTAL COMBAT FOR 2 TO 5 PLAYERS"
0240 PRINT
0260 PRINT
0500 REM CONSTANTS
0510 E=100: C1=15: C2=5: C3=15
0520 X1=15:Y1=11
0530 B=61440
0540 M=5
0550 LINE= 0
0560 DIM T(8)
0565 DATA 132,4,2,0,128,256,258,260
0570 FOR I=1 TO 8: READ T(I): NEXT I
0575 DIM U(3,3)
0580 DATA 4,5,6,3,0,7,2,1,8
0585 FOR I=1 TO 3: FOR I1=1 TO 3: READ U(I,I1): NEXT I1: NEXT I
0700 REM FUNCTIONS
0710 DEF FNA(X)=6*(X-1)+1
0800 REM ARRAYS
0810 DIM L(M),L1(M)
0820 DIM S(M),S1(M),S2(M)
0830 DIM X(M),Y(M),F(M)
0840 DIM J(M)
1000 REM ARENA PROGRAM
1001 GOSUB 1500
1100 REM MAIN LOOP
1110 GOSUB 2000
1120 GOSUB 9300
1130 IF Z>1 THEN 1100 :REM TWO OR MORE ALIVE
1150 GOSUB 2500
1170 PRINT "PLAY AGAIN";
1180 GOSUB 9000
1190 ON I9 GOTO 1000,1200
1200 END
1500 REM INITIALIZE SUBROUTINE
1505 N$="":REM CLEAR NAMES
1510 PRINT "ENTER NUMBER OF PLAYERS ( 2 TO ";M;")";
1520 INPUT N
1530 N=INT(N)
1540 IF N>M THEN 1500
1550 IF N<2 THEN 1500
1570 GOSUB 1800
1600 FOR I=1 TO N
1610 S(I)=2
1620 S1(I)=0:S2(I)=0
1630 L(I)=E: L1(I)=E/2
1640 J(I)=0
1650 GOSUB 1700
1660 NEXT I
1670 ON N GOSUB 3000,3100,3200,3400,3600,3800
1690 RETURN
1700 REM NAME ENTRY PROCESSOR
1710 PRINT "PLAYER ";I;"- ENTER YOUR NAME (1 TO 6 CHARS)";
1720 INPUT A$:IF LEN(A$)=0 THEN 1700
1730 IF LEN(A$)>6 THEN 1700
1735 GOSUB 1900: IF I9=1 THEN 1770
1740 A$=A$+"      ":A$=LEFT$(A$,6)
1750 N$=N$+A$
1760 RETURN
1770 REM ENTRY POINT
1780 PRINT "EACH NAME MUST START WITH A UNIQUE FIRST CHARACTER"
1790 GOTO 1700
1800 REM RANDOMIZE
1810 INPUT "ENTER A SIX DIGIT NUMBER",I9
1820 I9=RND(I9)
1830 RETURN
1900 REM NAME CHECK
```

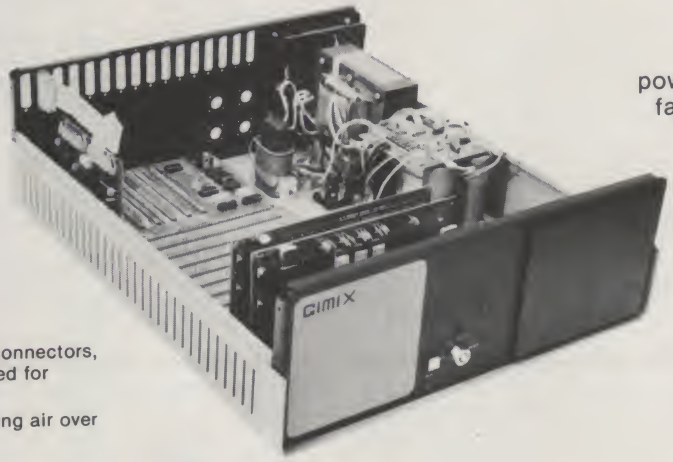
```
1905 I9=0
1910 IF I=1 THEN RETURN
1920 FOR I3=1 TO I
1930 IF LEFT$(A$,1)=MID$(N$,6*(I3-1)+1,1) THEN LET I9=1
1940 NEXT I3: RETURN
2000 REM TURN SBROUTINE
2010 GOSUB 2100
2020 FOR I4=1 TO N
2030 GOSUB 2300
2040 GOSUB 4000
2050 NEXT I4
2060 RETURN
2100 REM ORDER PLAYERS FOR THIS TURN
2110 FOR I=1 TO N
2120 S1(I)=RND+1-S2(I)
2130 S2(I)=0
2140 NEXT I
2150 RETURN
2300 REM SELECT THE NEXT PLAYER TO MOVE
2310 I=1
2320 FOR I2=1 TO N
2330 IF S1(I2)>S1(I) THEN LET I=I2
2340 NEXT I2
2345 S1(I)=0
2350 RETURN
2500 REM FINALIZE SUBROUTINE
2510 RETURN
3000 REM POSITION 1 PLAYER
3010 X(1)=1
3020 Y(1)=(Y1+1)/2
3030 F(1)=1
3050 RETURN
3100 REM POSITION 2 PLAYERS
3110 X(2)=X1
3120 Y(2)=(Y1+1)/2
3130 F(2)=5
3140 GOSUB 3000
3150 RETURN
3200 REM POSITION 3 PLAYERS
3210 X(1)=1
3220 Y(1)=(Y1+1)/2
3230 F(1)=1
3240 S2(1)=1
3260 X(2)=INT(3*(X1+1)/4)
3270 Y(2)=1
3280 F(2)=7
3310 X(3)=X(2)
3320 Y(3)=Y1
3330 F(3)=3
3350 RETURN
3400 REM POSITION 4 PLAYERS
3410 GOSUB 3100
3420 X(3)=(X1+1)/2
3430 Y(3)=1
3440 F(3)=7
3460 X(4)=X(3)
3470 Y(4)=Y1
3480 F(4)=3
3490 RETURN
3600 REM POSITION 5 PLAYERS
3610 GOSUB 3400
3620 X(5)=(X1+1)/2
3630 Y(5)=(Y1+1)/2
3640 F(5)=INT(8*RND+1)
3660 S2(5)=-1
3670 RETURN
4000 REM MOVE SUBROUTINE
4010 IF S(I)=0 THEN RETURN
4120 M1=L(I)
4125 M4=0
4130 IF S(I)<>1 THEN 4200
4140 M1=M1/2: J(I)=0
4200 FOR I3=1 TO N
4210 IF J(I3)=I THEN LET M4=M4+1
4220 NEXT I3
4230 GOSUB 4500
4235 M2=J(I)
4240 J(I)=0
4310 GOSUB 6000
4320 GOSUB 4400
4330 S(I)=2
4340 IF J(I)=0 THEN RETURN
4360 GOSUB 8000
4370 RETURN
4400 REM ATTACK % ADJUSTER
4410 PRINT "YOUR ATTENTION IS ";L1(I);"% ON ATTACK AND ";
4420 PRINT 100-L1(I);"% ON DEFENSE. OK";
4430 GOSUB 9000
4440 IF I9=1 THEN RETURN
4450 INPUT "ENTER NEW ATTACK %",L1(I)
4460 L1(I)=INT(L1(I))
4470 IF L1(I)<0 THEN 4450
4480 IF L1(I)>100 THEN 4450
4490 RETURN
4500 REM DISPLAY PROCESSOR
4505 PRINT CHR$(12);
4510 PRINT MID$(N$,6*(I-1)+1,6);" HIT RETURN.";
4520 INPUT A$
4525 PRINT CHR$(12);
4530 GOSUB 4600: GOSUB 4900
4535 I3=1: GOSUB 4700: PRINT
4540 I3=2: GOSUB 4800: GOSUB 5000
4545 I3=3: GOSUB 4700: PRINT
4550 I3=4: GOSUB 4800: GOSUB 5100
4555 I3=5: GOSUB 4700: GOSUB 5200
4560 I3=6: GOSUB 4800: GOSUB 5300
4565 I3=7: GOSUB 4700: PRINT TAB(36);"FACING:"
4570 I3=8: GOSUB 4800: GOSUB 5400
4575 I3=9: GOSUB 4700: GOSUB 5500
4580 I3=0: GOSUB 4800: GOSUB 5600
4585 I3=1: GOSUB 4700: GOSUB 5700
4590 GOSUB 4600: GOSUB 5800
4595 GOSUB 5900: RETURN
4600 REM DSPLY MAP EDGE
4610 PRINT "* 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 *";
4620 RETURN
4700 REM DSPLY ODD MAP LINE
4710 PRINT I3;"                                    ";I3;
4720 RETURN
4800 REM DSPLY EVEN MAP LINE
4810 PRINT I3;"  .  .  .  .  .  .  .  .  ";I3;
4820 RETURN
4900 REM DSPLY NAME
4910 PRINT TAB(36);
4920 PRINT MID$(N$,FNA(I),6);"'S TURN - - -"
4960 RETURN
5000 REM DSPLY CONDITION
5010 PRINT TAB(36);"YOUR CONDITION IS ";
5020 IF L(I)>=80 THEN PRINT "GOOD (";STR$(L(I));")":RETURN
5030 IF L(I)>=60 THEN PRINT "FAIR (";STR$(L(I));")":RETURN
5040 IF L(I)>=40 THEN PRINT "POOR (";STR$(L(I));")":RETURN
5050 PRINT "BAD (";STR$(L(I));")":RETURN
5100 REM DSPLY ATTACKING
5105 IF S(I)=1 THEN 5150
5110 IF J(I)=0 THEN PRINT:RETURN
5120 PRINT TAB(36);"YOU ARE ATTACKING ";
5130 PRINT MID$(N$,6*(J(I)-1)+1,6)
5140 RETURN
5150 REM ENTRY
5160 PRINT TAB(36);"YOU ARE STUNNED"
5170 RETURN
5200 REM DSPLY ENGAGED 1
5210 IF M4=0 THEN PRINT:RETURN
5220 PRINT TAB(36);"YOU ARE ENGAGED BY ";
5230 I6=0 :REM THIS VALUE USED IN SUBROUTINE 5300
5240 GOSUB 9100
5250 PRINT MID$(N$,6*(I6-1)+1,6);
5260 IF M4>2 THEN PRINT ",";
5270 PRINT :RETURN
5300 REM DSPLY ENGAGED 2
5310 IF M4<2 THEN PRINT:RETURN
5315 PRINT TAB(36);
5320 IF M4>3 THEN GOSUB 9100 :PRINT MID$(N$,6*(I6-1)+1,6);", ";
5330 IF M4>2 THEN GOSUB 9100 :PRINT MID$(N$,6*(I6-1)+1,6);" ";
5335 GOSUB 9100
5340 PRINT "AND ";MID$(N$,6*(I6-1)+1,6)
5350 RETURN
5400 REM DSPLY FACING 1
5410 A$=" 4 3 2"
5420 GOSUB 9200
5430 RETURN
5500 REM DSPLY FACING 2
5510 A$="  \|/ "
5520 GOSUB 9200
5530 RETURN
5600 REM DSPLY FACING 3
5610 A$=" 5- -1"
5620 GOSUB 9200
5630 RETURN
5700 REM DSPLY FACING 4
5710 A$="  /|\ "
5720 GOSUB 9200
5730 RETURN
5800 REM DSPLY FACING 5
5810 A$=" 6 7 8"
5820 GOSUB 9200
5830 RETURN
5900 REM POKE PLAYER ONTO SCREEN
5910 FOR I3=1 TO N
5920 POKE( B+64*Y(I3)+2*X(I3),ASC(MID$(N$,6*(I3-1)+1,1)))
5930 POKE( B+671+6*I3,ASC(MID$(N$,6*(I3-1)+1,1)))
5935 POKE( B+541+T(F(I3))+6*I3,42)
5940 NEXT I3
5950 RETURN
6000 REM OPTIONS PRICESSOR
6010 PRINT "YOUR OPTIONS ARE ";
6020 IF S(I)<>1 THEN PRINT "ATTACK, ";
6030 IF M4=0 THEN PRINT "MOVE, ";
6040 IF M4<>0 THEN PRINT "DISENGAGE, ";
6050 PRINT "TURN OR STAND. CHOOSE ONE";
6100 INPUT A$
6110 IF LEFT$(A$,1)="A" THEN GOTO 6200
6120 IF LEFT$(A$,1)="D" THEN GOTO 7000
6130 IF LEFT$(A$,1)="M" THEN GOTO 6400
6140 IF LEFT$(A$,1)="T" THEN GOTO 6700
6150 IF LEFT$(A$,1)="S" THEN GOTO 6900
6155 REM ENTRY POINT
6160 PRINT "WHAT";
6170 GOTO 6100
6200 REM ATTACK
6205 IF S(I)=1 THEN PRINT "WHAT";: GOTO 6100
6207 IF M2<>0 THEN J(I)=M2:RETURN
6210 INPUT "ATTACK WHO",A$
6215 I3=0
6220 FOR I2=1 TO N
6230 IF LEFT$(A$,1)=MID$(N$,6*(I2-1)+1,1) THEN LET I3=I2
6240 NEXT I2
6245 IF I3=0 THEN 6200
6250 IF I=I3 THEN PRINT "YOU CAN'T ATTACK YOURSELF. ";: GOTO6000
6260 M5=X(I3)-X(I): M6=Y(I3)-Y(I): GOSUB 9400
6270 IF M7<>0 THEN 6300
6280 PRINT "YOU MUST BE NEXT TO THE PERSON YOU ATTACK."
6290 GOTO 6000
6300 IF F(I)=M7 THEN LET J(I)=I3: RETURN
6310 PRINT "YOU MUST BE FACING THE PERSON YOU ATTACK."
6320 GOTO 6000
6400 REM MOVEMENT
6405 IF M4<>0 THEN 6155
6407 PRINT "YOUR CURRENT POSITION IS ";
6408 PRINT STR$(X(I));",";STR$(Y(I));
6410 INPUT ".  ENTER NEW POSITION",M5,M6
6420 GOSUB 6600
6430 IF M7=0 THEN 6500
6440 PRINT "YOUR NEW POSITION IS ";
6450 IF M7=1 THEN PRINT "OUT OF RANGE. ";
6460 IF M7=2 THEN PRINT "OCCUPIED. ";
6465 IF M7=3 THEN PRINT "OUT OF BOUNDS. ";
6470 PRINT "TRY AGAIN.": GOTO 6000
6500 I9=C1*(ABS(M5-X(I))+ABS(M6-Y(I)))
6510 IF I9>M1 THEN PRINT "NO ENOUGH ENERGY. ";: GOTO 6000
6520 X(I)=M5: Y(I)=M6: M1=M1-I9
6525 S2(I)=.3
6530 PRINT "YOUR FACING IS ";F(I);".  OK";
6540 GOSUB 9000: IF I9=1 THEN RETURN
6550 GOSUB 6700: RETURN
6600 REM MOVE CHECK
6610 M7=0: M5=INT(M5): M6=INT(M6)
6613 IF M5<1 THEN 6670
6615 IF M5>X1 THEN 6670
6617 IF M6<1 THEN 6670
```



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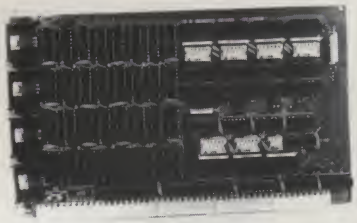
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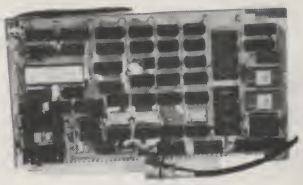
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```
6619 IF M6>Y1 THEN 6670
6620 IF ABS(M5-X(I))>4 THEN LET M7=1: RETURN
6630 IF ABS(M6-Y(I))>4 THEN LET M7=1: RETURN
6640 FOR I2=1 TO N
6650 IF M5=X(I2) THEN IF M6=Y(I2) THEN LET M7=2
6660 NEXT I2: RETURN
6670 REM ENTRY POINT
6680 M7=3: RETURN
6700 REM FACING PROCESSOR
6710 INPUT "ENTER FACING (1 TO 8)",I9
6720 IF I9<1 THEN 6700
6730 IF I9>8 THEN 6700
6732 I2=ABS(I9-F(I))
6734 IF I2>4 THEN LET I2=8-I2
6735 M1=M1-C2*I2
6737 IF M1<0 THEN LET M1=0
6740 F(I)=INT(I9): RETURN
6900 REM STAND
6910 RETURN
7000 REM DISENGAGE
7010 INPUT "DISENGAGE FROM WHO",A$
7012 I1=0:FOR I2=1 TO N
7014 IF LEFT$(A$,1)=MID$(N$,FNA(I2),1) THEN LET I1=I2
7016 NEXT I2
7018 IF I1=0 THEN 7000
7020 IF I<>J(I1) THEN PRINT "NOT ENGAGED": GOTO 6000
7030 IF M1<C3 THEN PRINT "NOT ENOUGH ENERGY": GOTO 6000
7040 IF RND>.5 THEN PRINT "ATTEMPT FAILED": RETURN
7050 J(I1)=0
7060 M1=M1-C3: I2=0
7070 FOR I3=1 TO N
7080 IF I=J(I3) THEN I2=I3
7090 NEXT I3
7110 IF I2<>0 THEN RETURN
7120 M5=2*X(I)-X(I1)
7130 M6=2*Y(I)-Y(I1)
7140 GOSUB 6600
7150 IF M7<>0 THEN RETURN
7160 X(I)=M5: Y(I)=M6
7170 RETURN
8000 REM ATTACK PROCESSOR
8005 PRINT CHR$(12);
8010 PRINT MID$(N$,FNA(I),6);" AND ";MID$(N$,FNA(J(I)),6);
8020 INPUT " HIT RETURN",A$
8030 PRINT CHR$(12);MID$(N$,FNA(I),6);" SWINGS AT ";
8040 PRINT MID$(N$,FNA(J(I)),6);" AND ";
8050 I9=(.9*L(I)-.1*M1)*(L1(I)+1)/100*(RND+1)
8060 I9=I9-(L(J(I))*(101-(L1(J(I))))/100*(RND+1))
8065 I9=INT(I9/2)
8070 GOSUB 9500
8080 IF I9<=0 THEN 8200
8090 PRINT "HITS FOR ";I9;"POINTS."
8095 I3=J(I): GOSUB 8100: GOTO 8900
8100 REM DAMMAGE SUBROUTINE
8105 S2(I3)=.6
8110 IF I9<=L(I3)/2 THEN LET L(I3)=L(I3)-I9: RETURN
8120 PRINT MID$(N$,FNA(I3),6);" IS ";
8130 IF I9>=L(I3) THEN 8500
8135 S2(I3)=.9
8140 L(I3)=L(I3)-I9: PRINT "STUNNED": S(I3)=1
8150 RETURN
8200 REM MISSED
8210 I9=ABS(I9)
8220 IF I9>20 THEN 8300
8230 PRINT :PRINT MID$(N$,FNA(J(I)),6);" DODGES HIS BLOW."
8290 GOTO 8900
8300 REM RETURN SWING
8310 IF I9>40 THEN PRINT: PRINT MID$(N$,FNA(J(I)),6);" PARRIES"
8320 IF I9<=40 THEN PRINT "MISSES"
8330 I9=I9+L(J(I))*(L1(J(I))+1)/100*(RND+1)
8340 I9=I9-L(I)*(101-L1(I))/100*(RND+1)
8345 I9=INT(I9/2)
8350 PRINT : PRINT MID$(N$,FNA(J(I)),6);" SWINGS AT ";
8360 PRINT MID$(N$,FNA(I),6);" AND ";
8370 GOSUB 9500: IF I9<=0 THEN 8400
8380 PRINT "HITS FOR ";I9;"POINTS."
8390 I3=I: GOSUB 8100: GOTO 8900
8400 REM NO HIT
8410 PRINT "MISSES."
8420 GOTO 8900
8500 REM DEAD SUBROUTINE
8510 PRINT "DEAD"
8520 S(I3)=0: J(I3)=0
8530 RETURN
8900 REM END OF FIGHT
8910 PRINT "HIT RETURN."
8920 INPUT A$: RETURN
9000 REM YES OR NO INPUT PROCESSOR
9001 I9=1
9010 INPUT A$
9015 IF A$ = "" THEN RETURN
9020 IF LEFT$(A$,1)="Y" THEN RETURN
9030 IF LEFT$(A$,1)<>"N" THEN 9050
9040 I9=2:RETURN
9050 PRINT "PLEASE ANSWER YES ( OR Y ) OR NO ( OR N )";
9060 GOTO 9000
9100 REM FIND NEXT ATTACKER
9110 I6=I6+1
9120 IF J(I6)=I THEN RETURN
9130 IF I6<N THEN GOTO 9100
9140 PRINT "PROGRAM LOGIC ERROR - 9140" :END
9200 REM FACING PRINT LOOP
9210 PRINT TAB(35);
9220 FOR I3=1 TO N
9230 PRINT A$;
9240 NEXT I3
9250 PRINT :RETURN
9300 REM COUNT THE LIVING
9310 Z=0
9320 FOR I3=1 TO N
9330 IF S(I3)<>0 THEN LET Z=Z+1
9340 NEXT I3
9350 RETURN
9400 REM ADJACENCY TEST
9410 M7=0
9420 IF ABS(M5)>1 THEN RETURN
9430 IF ABS(M6)>1 THEN RETURN
9440 M7=U(M5+2,M6+2): RETURN
9500 REM SPIN WHEELS
9505 RETURN
```

Starting Energy	E	100
Cost To Move 1 Space	C1	15
Cost to turn 45°	C2	5
Cost to Disengage	C3	15
X dimension of Arena	X1	15
Y dimension of Arena	Y1	11
Base address of screen	B	61440
Maximum number of players	M	5
Facing Display Table	T(8)	
Displacement to Facing Table	U(3,3)	

Table 1. Constants (500 to 699).

L(M)	Energy	S(M)	Status
L1(M)	Combat %	S1(M)	Order
X(M)	Position	S2(M)	Order Adjust
Y(M)	Position	F(M)	Facing
J(M)	Attack Pointer		

Table 2. Arrays (800 to 899).

terminal equipped with cursor addressing.

Program Conventions and Structure

Arena is a highly modular program. It was designed and tested in a top-down fashion using stubs (unexpanded subroutines) where necessary. All subroutines start at lines that are even multiples of 100, and most GOTO destinations follow the same rule. Named constants are used to facilitate program changes.

Fig. 2 is a generalized flowchart of Arena. Figs. 3 and 4 expand major subroutines. These figures are intended as a guide to the program listing.

Table 1 lists all constants used in Arena. Literal constants have been purposely avoided. Tables 2 and 3 list all variables and arrays used in the program. I maintained these tables throughout the development effort and found them to be invaluable tools. Table 4 lists all valid status codes for the player status array and the move check status variable.

Two stubs remain in Arena. SPIN WHEELS at line 9500 was intended to induce dramatic pauses into the output. While play testing the game, I decided this feature did not enhance the game, so I removed it. FINALIZE SUBROUTINE at line 2500 was intended to print statistical information at the end of the game. You can include this routine as an enhancement to Arena.■

I	Player Number
I1	Loop Counter
I2	Loop Counter
I3	Loop Counter
I4	Display Counter
I6	Engaged Pointer
I9	Working Variable
N	Number of Players
N$	Names String
A$	Working String
M1	Energy Left
M4	Number Engaging
M5	X Destination
M6	Y Destination
M7	Move Check Status
M2	Current Attack Pointer

Table 3. Variables.

Player	Move Check
0 = dead	0 = OK
1 = stunned	1 = too far
2 = normal	2 = already occupied

Table 4. Status values.

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File Directory Analysis for North Star DOS

Are your NS disk files getting out of hand? This useful program will help you organize them.

Edwin Milne
512-75 Eastdale Ave.
Toronto, Ontario
Canada M4C 5N3

This program analyzes and prints the file directory on diskettes created by North Star's DOS. I have had a single North Star disk drive for almost a year now, but my files and diskettes were getting out of control. I developed this program so that I could obtain a permanent list on my printer of the contents of my diskettes.

At the same time, I added routines to check the file usage on the diskette so that I could tell which files were allocated more space than they needed. I can now find any file in my system in short order and, by using the space on my diskettes more efficiently, I have stopped beating a path to the door of my local computer store to buy more diskettes.

Operation

The program has four main phases: read the directory and extract the active entries; sort the entries into name sequence; analyze and print each entry; and print statistics on the entire diskette.

In order to read the directory, the first four blocks of the diskette must be defined as a BASIC file with the DOS commands:

CR★★★★★★★★★40
TY★★★★★★★★★3

The directory is given a file name of ★★★★★★★★★ so it will not interfere with any legitimate file name. Because this file occupies the lowest possible address on the diskette, it will not be moved by a compact command.

Because the directory is not formatted as a BASIC file, it must be read as a series of single bytes. If the first byte of the file name is a space, then that directory entry is not active and is bypassed. The entry for the directory file itself is also bypassed. The complete data for each active entry is added to the table (D$).

When the entire directory has been read, the table is sorted into file-name sequence using the Shell-Metzner technique. (See "5 Minutes or 5 Hours?" *Kilobaud*, May 1978, p. 100.)

Before the printing starts, the program asks for the date and the diskette number so that these can be included on the report heading. For each active directory entry, the program prints:

- file name
- file type (both numeric code and alphabetic description)
- starting address
- space allocated

Additional information is printed depending upon the file type. For program files (type 1), the load address is printed in hex. For BASIC programs (type 2) and BASIC files (type 3), the program prints the number of blocks and the percent of the allocated space actually used. The number of blocks used for BASIC programs is taken from the directory entry, but to get the actual usage of BASIC files the entire file is read and the size of each field is accumulated.

At the end of the report, the program prints the following statistical data:

- the number of files on the disk
- the number of blocks and percentage of the diskette which has been allocated
- the largest new file which could be created without compacting the disk
- the amount of space, if any, which could be made available by compacting the diskette.

The program normally takes 30-60 seconds to complete the report for a diskette depending upon the number of files and especially upon the number of BASIC files on the diskette.

The program is written directly in North Star BASIC, except for the references to the printer. My monitor assumes that device #1 is the printer so that PRINT statements appear on the console and PRINT #1

A$(20)	Report Date
B$	Disk Number
D$(N)	Directory Area
F$	File Name
H(4)	Decimal-to-Hex Conversion Table
H1(4)	Decimal-to-Hex Conversion Table
H$(16)	List of Hex Characters
I	Loop Counter
J	Loop Counter
K	Temporary Variable
L	Temporary Variable
M	Temporary Variable
N	Size of Directory Area—4 Blocks
O	Number of Directory Entries in D$
Q1$(18)	String for Print Spacing
Q2$(39)	String for Print Spacing
R	Disk Address
R9	Highest Address Allocated on Disk
S	Number of Blocks in File
S9	Total Number of Blocks Allocated on the Disk
T	File Type
U	Number of Characters used in the File
U1	Number of Blocks used
W1	Temporary Variable
W2	Temporary Variable
X$(16)	Directory Entries Work Area
Z$(1000)	Temporary Variable to Read Data Files

Variables list.

statements appear on the printer. In line 1550, I issue a special set of codes to cause my printer to skip to the top of a new page. In line 1900, I generate 256 nulls to the printer to flush the last line out of the monitor's buffer to the printer.

I inserted the PRINT statements in lines 1330, 1340 and 1390 to give me something to watch on the console during the first part of the program and to reassure me that the program had not gone into a loop. In line 2050, the program prints out the name of each BASIC file that it reads. If a file has been created as a BASIC file but has not yet been written into, the program will abort with a TYPE error. This print line tells which file caused the problem.

Modifications

This program can be enhanced in several ways. As given here, the program only considers the standard North Star file types. You can define your own codes for any other types of files that you have on your system. It is simple to add additional descriptions in lines 1670 to 1730, which can be of great benefit in determining the contents of a diskette.

In an expanded version of this program, which contains my own unique file codes, I indicate backup versions of files by adding 128 to the normal file-type code. It is also possible to alter the program to read several directories before printing the report. If you have enough memory, you can produce a single combined list of all your files.

For anyone interested in converting the program for use with some other system, the North Star diskette contains 350 blocks of 256 bytes each. The first four blocks are reserved for the directory. The directory consists of a 16-byte entry for each file containing: file name (1-8), starting address for the file (9-10), number of blocks allocated for the file (11-12), file type (13) and user area (14-16).

The contents of the user area vary depending upon the file type. For programs (type 0), positions 14 and 15 contain the load address. For BASIC programs, position 14 contains the number of blocks that are actually used. This field is not used for other file types.

In calculating the size of BASIC files, each numeric value takes five bytes and each string takes its own length plus two bytes. If the string is larger than 255 bytes, it takes an additional byte. There is also a one-byte marker at the end of the file.

Naturally, North Star BASIC has its own peculiarities. The TYP function returns a numeric value describing the next item on the file:

0 means end of file.
1 means a string is next.
2 means a numeric value is next.

There are no string arrays as such. The DIM statement for a string actually defines the length of the string. For example, DIM Z$ (1000) defines a single string 1000 bytes long. Index values after a string define sub-strings. For example, D$ (1, 16) gives the first 16 bytes of D$. This sub-string mechanism is used in the program to treat D$ as an array of 16-byte strings.

The items starting with a percent sign (%) in the PRINT statement define the format of numeric items and are equivalent to PRINT USING. The format statements used in the program are:

%nI—print the following variables as an integer of n digits.

%nFm—print the following variables as an n character field with m digits to the right of the decimal point.

The READ statements containing a variable prefixed with an ampersand (&) read the next byte of the disk file as a numeric value. For example, a space (hex 20) would be read as

File Name	Type	Address	Size	User Area	Blocks Used	% Used
ARTICLE	0 UNDEFINED	171	87			
DATA	3 BASIC FILE	4	2		2	97%
NSBASIC	1 PROGRAM	122	45	2A00		
PDIREC	2 BASIC PROGRAM	74	20		16	80%
RESUMEE	4 UNDEFINED	4	30			
SPLSPEC	4 UNDEFINED	34	40			

6 FILES ON DISK.
TOTAL OF 224 BLOCKS (65.%) USED.
LARGEST NEW FILE IS 92 BLOCKS.
30 BLOCKS AVAILABLE BY COMPACTION.

Example 1. Output report.

Program listing.

```
1000 PRINT \ PRINT \ PRINT  "PRINT DIRECTORY LISTING"
1010 PRINT "VER 1.0  10 NOV 78" \ PRINT
1020 REM INITIALIZATION
1030 N=1024
1040 DIM D$(N),X$(16),A$(20),H$(16),H(4),H1(4),Z$(1000),Q1$(18),Q2$(39)
1050 H$="0123456789ABCDEF"
1060 FOR I=1 TO 4
1070  READ H(I),H1(I)
1080  NEXT I
1090 DATA 128,8
1100 DATA 64,4
1110 DATA 32,2
1120 DATA 16,1
1130 LINE #1,132
1140 REM
1150 REM LOAD DIRECTORY INTO D$
1160 REM
1170 OPEN #0,"*********"
1180 O=1 \ I=0
1190  READ #0,&D
1200  IF D=32 THEN 1290
1210  X$="          "
1220  FOR J=1 TO 8 \ X$(J,J)=CHR$(D) \ READ #0,&D \ NEXT J
1230  IF X$="*********" THEN 1300
1240   REM STORE DATA FROM ACTIVE DIRECTORY ENTRY IN D$
1250   W1=FNA(O) \ D$(W1,W1+7)=X$ \ D$(W1+8,W1+8)=CHR$(D)
1260   FOR J=W1+9 TO W1+15 \ READ #0,&D \ D$(J,J)=CHR$(D) \ NEXT J
1270   O=O+1 \ I=I+1
1280   IF I<64 THEN 1190 ELSE 1330
1290   READ #0,&D,&D,&D,&D,&D,&D,&D,&D \ REM READ PAST BLANK ENTRY
1300  READ #0,&D,&D,&D,&D,&D,&D,&D
1310  I=I+1
1320  IF I<64 THEN 1190
1330 CLOSE #0 \ PRINT "FILE LOADED INTO MEMORY"
1340 O=O-1 \ PRINT O," ENTRIES"
1350 IF O>1 THEN 1370 ELSE IF O=1 THEN 1530
    ELSE PRINT "NO ACTIVE ENTRIES ON THIS DISK" \ END
1360 REM SORT DIRECTORY BY FILE NAME - SHELL METZNER
1370 M=O
1380 M=INT(M/2)
1390 IF M=0 THEN 1530 ELSE PRINT M," SEQUENCES"
1400 J=1 \ K=O-M
1410 I=J
1420 L=I+M
1430 W1=FNA(I) \ W2=FNA(L)
1440 IF D$(W1,W1+7)<=D$(W2,W2+7) THEN 1480
1450 X$=D$(W1,W1+15) \ D$(W1,W1+15)=D$(W2,W2+15) \ D$(W2,W2+15)=X$
1460 I=I-M
1470 IF I>=1 THEN 1420
1480 J=J+1
1490 IF J>K THEN 1380 ELSE 1410
1500 REM
```

```
1510 REM PRINT REPORT
1520 REM
1530 INPUT "ENTER DATE ",A$
1540 INPUT "ENTER DISK NUMBER ",B$
1550 PRINT #1,CHR$(27),CHR$(10),CHR$(27),CHR$(10),CHR$(12), \
   REM SKIP PAPER TO HEAD OF PAGE
1560 PRINT #1,""
1570 PRINT #1,Q1$,"- DISK ",B$," -"
1580 PRINT #1,""
1590 PRINT #1,"            DIRECTORY LIST AS AT ",A$
1600 PRINT #1,""
1610 PRINT #1,Q2$,"USER BLOCKS   %"
1620 PRINT #1,"FILE NAME   TYPE         ADDRESS SIZE  AREA  USED  USED"
1630 PRINT #1,""
1640 FOR I=1 TO O*16 STEP 16
1650  PRINT #1,D$(I,I+7),
1660  T=ASC(D$(I+12))
1670  IF T>3 THEN L=1 ELSE L=T+1
1680  PRINT #1,%3I,T," ",
1690  ON L GOTO 1700,1710,1720,1730
1700  PRINT #1,"UNDEFINED      ", \ GOTO 1740
1710  PRINT #1,"PROGRAM        ", \ GOTO 1740
1720  PRINT #1,"BASIC PROGRAM  ", \ GOTO 1740
1730  PRINT #1,"BASIC FILE     ", \ GOTO 1740
1740  R=ASC(D$(I+8))+ASC(D$(I+9))*256
1750  S=ASC(D$(I+10))+ASC(D$(I+11))*256 \ S9=S9+S
1760  IF R+S>R9 THEN R9=R+S
1770  PRINT #1,%3I,R,%7I,S,
1780  ON L GOTO 1830,1790,1800,1810
1790  GOSUB 1930 \ GOTO 1830
1800  U1=ASC(D$(I+13)) \ U=U1*256 \ GOTO 1820
1810  GOSUB 2040 \ GOTO 1820
1820  PRINT #1,"          ",%3I,U1,"  ",INT(100*U/(S*256)+.5),"%",
1830  PRINT #1,""
1840  NEXT I
1850 PRINT #1,"" \ PRINT #1,%2I,O," FILES ON DISK."
1860 PRINT #1,"" \
   PRINT #1,"TOTAL OF",S9," BLOCKS (",%4F0,100*S9/346,"%) USED."
1870 PRINT #1,"" \ PRINT #1,"LARGEST NEW FILE IS ",%3I,350-R9," BLOCKS."
1880 PRINT #1,"" \ IF R9>S9+4 THEN PRINT #1,%3I,R9-S9-4," BLOCKS ", ELSE
PRINT #1,"NO SPACE ",
1890 PRINT #1,"AVAILABLE BY COMPACTION."
1900 FOR I=1 TO 256 \ PRINT #1,CHR$(0), \ NEXT I \ REM FLUSH OUT BUFFER
1910 END
1920 REM FILE TYPE 1 GET LOAD ADDRESSS
1930 PRINT #1,"   ",
1940 FOR J=I+14 TO I+13 STEP -1
1950  K=ASC(D$(J)) \ L=0
1960  FOR M=1 TO 4
1970   IF K<H(M) THEN 1980 ELSE L=L+H1(M) \ K=K-H(M)
1980   NEXT M
1990  L=L+1 \ K=K+1
2000  PRINT #1,H$(L,L),H$(K,K),
2010  NEXT J
2020 RETURN
2030 REM CALCULATE SPACE USED FOR BASIC FILE
2040  U=0 \ F$=D$(I,I+7) \ OPEN #0,F$
2050  PRINT "READING ",F$," AS BASIC FILE"
2060  ON TYP(0)+1 GOTO 2110,2070,2100
2070  READ #0,Z$ \ U=U+LEN(Z$)
2080  IF LEN(Z$)>255 THEN U=U+3 ELSE U=U+2
2090  GOTO 2060
2100  READ #0,Z \ U=U+5 \ GOTO 2060
2110  CLOSE #0 \ U=U+1
2120 U1=INT(U/256) \ IF U1*256<U THEN U1=U1+1
2130 RETURN
2140 REM FUNCTION TO CALCULATE ADDRESS OF DIRECTORY ENTRY IN TABLE
2150 DEF FNA(W) \ W=(W-1)*16+1 \ RETURN W
```

a numeric value of 32.

My System

Not wishing to show favoritism to any one manufacturer, I have assembled my system as follows: Z-80 CPU and System Monitor Board (Xitan), 16K (Xitan) and 32K (S.D. Sales), VDM video board, Sanyo video monitor, Cybernex keyboard, North Star disk drive and controller, Multiwriter III printer (built by a local firm around the Hytype II mechanism) and a Panasonic and a Sony cassette recorder.

The software I used for this article was: my own monitor, which includes a diassembled version of the North Star DOS Version 2, Release 3; North Star BASIC Version 6, Release 3; Xitan's Text Editor; and a modified version of Xitan's Text Output Processor.■

```
RUN


PRINT DIRECTORY LISTING
VER 1.0  10NOV78

FILE LOADED INTO MEMORY
 6 ENTRIES
 3 SEQUENCES
 1 SEQUENCES
ENTER DATE 23NOV78
ENTER DISK NUMBER 11
READING DATA      AS BASIC FILE

READY
```

Sample run. Console listing.

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"Over the past four years we have taken delivery on over 25 computer systems. Only two have worked totally glitch free and without adjustment as they came out of the carton: The Tektronic 4051 (at $7,000 the most expensive computer we tested) and the Ohio Scientific Superboard II (at $279 the least expensive) . . . The Superboard II and companion C1P deserve your serious consideration."

Creative Computing January, 1979

"The Superboard II and its fully dressed companion the Challenger 1P series incorporate all the fundamental necessities of a personal computer at a very attractive price. With the expansion capabilities provided, this series becomes a very formidable competitor in the home computer area."

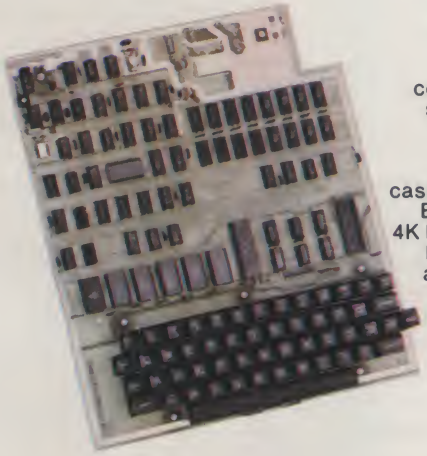
Interface Age April, 1979

"The graphics available permit some really dramatic effects and are relatively simple to program . . . The fact that the system can be easily expanded to include a floppy means that while you are starting out with a low-cost minimal system, you don't have to throw it away when you are ready to go on to more complex computer functions. Everything is there that you need; you simply build on to what you already have. You don't have to worry about trading off existing equipment to get the system that will really do what you want it to do. At $279, Superboard II is a tough act to follow."

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Report on the Centronics 779 Printer

The following "opinionated but accurate" evaluation of the Centronics 779 printer was derived from the author's use of the printer and study of the related technical manuals.

Glen A. Deibert
431 Dunmore Rd.
Fayetteville NC 28303

Many printers are available to the personal-computer hobbyists, but when the specifications are studied most of them have unacceptable characteristics. Business forms or letters on 5 inch adding-machine tape are not practical, nor is the use of specially coated paper totally suitable for professionals or serious hobbyists. The special paper is rather expensive, and multicopy prints are not possible unless several runs are made. And then there is the availibility of the special paper; all office-supply stores may not have this or similar paper.

Requirements

When I began my search for a printer, I set several requirements that would have to be met. I considered the most important requirement the supportability of the printer by the manufacturer and myself. My first requirement was, will the parts and service, if necessary, be available for the next five or more years?

My second requirement was reliability. Is the printer well constructed and will it withstand frequent usage with minimum failures? The third requirement concerned the printer manufacturer. Is it a reputable company or is it a newly formed business that is out to make a fast buck from the personal-computer market and will go out of business in several years?

My fourth requirement was an economical printing medium. I wanted a printer that would print on bond paper, Teletype paper, continuous fold paper or, for that matter, anything, within reason, that I put into the printer. My next, requirement was the printer speed. The ASR-33 and similiar printers are excellent machines, but rather slow. I desired a printer with at least a 50 cps print speed.

The last requirement was the cost. I considered that if a printer met all the above requirements, I could spend a little more for it than I could afford but would then have a first-class printer that would meet any future requirements, whether they be hobby or professional computing.

After a year of off-and-on searching, I accidently came across literature on the Centronics line of printers. These are commercial-grade printers manufactured by one of the leading manufacturers of inexpensive durable printers for industry. When I read the specifications of the Centronics line I found that they met or exceeded all my requirements, but I figured price tags would probably be too high. I was pleased to find that prices for the various models were reasonable.

I selected the Centronics 779 as the printer that would meet my needs and started getting price quotations from various sources. I was surprised at the price variations. As a matter of interest, the 779 has a striking similarity to the printer used on the TRS-80 offered by Radio Shack.

Performance

Now that I am the proud owner of a Centronics 779 printer, I can evaluate its performance in one word—excellent. The 779 is a self-contained printer. When I connected the signal/data cable between it and my SWTP 6800 system and typed in LIST #7, it started printing crisp and clear text. The 779 is quiet, not much noisier than an electric typewriter, and during printing there is a distinctive buzzing as the printhead moves across the paper printing out information.

The 779 comes packaged in a sturdy shipping box that should ensure against shipping damage. Unpacking/packing instructions are included in the box along with a 14-page operator's manual and a 3/8 inch thick technical manual that is most helpful in remedying any electromechanical failures and for performing preventative maintenance.

The operator's manual describes the 779 as a modular-constructed low-speed unidirectional impact printer capable of printing 5×7 dot matrix characters at print densities of 10 to 16.5 characters per inch. Table 1 shows the 779 print performance.

The 779 has two switches associated with its operation: a power switch that doubles as a circuit breaker and a print switch that allows the operator to control data between the printer and the interface. The print-density control is located on the rear of the printer and controls the frequency of an oscillator.

I found this a slight disadvantage since I have no way of knowing the exact print density to use. I would have preferred a multi-position switch that would allow selection of discrete print

Density	Print speed	10 char/line	80 char/line	132 char/line
10	60 cps	90 lpm	21 lpm	N/A
16.5	100 cps	130 lpm	36 lpm	21 lpm

Table 1.



The Centronics 779 printer.

densities, but this is a minor point. Table 2 shows the maximum and minimum print density of the 779 printer.

Maximum use is made of the print ribbon. An unusual configuration allows printing on the upper and lower portions of the ribbons on alternate passes. The ribbon is available in 30 ft. spools or 60 ft. zip packs.

Several options that provide additional operator and data handling convenience are available: (1) special 64-character set, (2) tractor feed and pin platen feed and (3) a printer stand. The basic printer comes with a pinch-roll paper feed that will handle paper up to 9.8 inches wide (perfect for printing form letters).

The 779 will respond to only two commands: carriage return and line feed. The automatic line feed on carriage return is a strapable option that generates an automatic line feed after the buffer contents are printed. Also present on the 779 are those fine points that you expect to find on a professional printer: print-penetration control, paper bail and tear bar, paper-empty switch and an excellent appearance.

Mechanics of the Printer

The printer case appears to be made of a high-impact plastic that is easily removed for access to the internal components for maintenance or troubleshooting and preventative maintenance. All of the electronics are contained on a single printed circuit board.

Included on the board is a line buffer that will handle parallel data at rates up to 75,000 characters per second. The printhead motion is controlled by one of two solenoids—one for forward motion and one for carriage return. The drive motor drives a belt at a constant speed in a clockwise direction. If the forward or print solenoid is activated, the solenoid will seize the upper half of the belt and move the carriage to the right. If the reverse solenoid is activated, it will seize the lower half of the belt and return the carriage assembly to the extreme left position.

On my printer this seemed to be a positive action, but I have noticed that occasionally the printhead will bounce several times before settling down in the start position and starting the next line.

The ribbon feed mechanism on the 779 is unusual from my point of experience. As the carriage is advanced, the ribbon drive shaft rotates and feeds ribbon out of the back of the ribbon cartridge, around to the front of the printhead and then back to the front of the cartridge. Movement of the ribbon drive shaft is caused by two one-way slip clutches—one for forward motion and one for backward motion (carriage return). Through an arrangement of pulleys and ribbon drive wires attached to the left and right side of the printer, movement of the carriage will cause the ribbon to feed in one direction and also cause the upper and lower half of the ribbon to be used for printing.

The left and right margin indicators are light-emitting diodes (LEDs) and phototransistors that indicate if the printhead is at the start position or at the extreme right. The carriage arm has tangs on the left and right side that mask the light source (LED) when the carriage is in either of the two extreme positions. There are two methods of moving paper in the 779: (1) manually by using the platen knob and rotating it clockwise and (2) automatically by a decode line-feed signal which causes activation of a solenoid that allows a line-feed clutch to advance the paper one line.

The actual printing is performed by selective activation of the seven print wires in the printhead. These wires are aligned in a vertical column in the printhead. The print command to the seven wires is developed in a read-only memory (ROM). Each character in a ROM is addressed by a 7-bit character code, and each column within a character is specified by timing signals developed in the printer.

In my opinion, the Centronics 779 printer is an excellent investment for the serious hobbyist or the professional. Dollar for dollar it will be difficult to find a better or more practical printer for mini/microcomputer users. It is a rugged, precisely built piece of equipment that should provide many hours of trouble-free operating time. The Centronics line of printers is manufactured by Centronics Data Computer Corporation, Hudson NH 03051. ■

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

1234567890-I^:;/.!#$%&'()=I^*+?><

THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK

ABCDEFGHIJKLMNOPQRSTUVWXYZ

1234567890-IC^:;/.!#$%&'()=IC^*+?><

THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK
```

Table 2.

Kendal T. Rogers
8802 Nightingale Ave.
Fountain Valley CA 92708

Beefing Up PET

You can have machine language and BASIC too in your PET.

I recently purchased a Commodore PET microcomputer and have been very happy with using it for small jobs, games, etc. However, having performed machine-language programming on various machines in the past, I was curious to see how the PET would perform using machine language versus the native BASIC.

Introduction

I wrote up small programs in BASIC and machine language (ML) to print about half a screen of characters. Then I measured the BASIC program's time, which was about 3 seconds. As far as I could tell, the ML program was instantaneous. Using the system's 256 microsecond clock, I finally measured about 6 milliseconds for the ML execution time, or 500 times faster than BASIC!

This whetted my appetite to write ML code for cases where BASIC was obviously gumming up the action. However, even the production of my small ML program was somewhat painful—having to do the coding of the 6502 microprocessor instructions, translate to decimal, POKE them in and finally execute. Of course, it didn't work the first time and crashed the system. So debugging was necessary . . . and painful. Clearly, this was no way to do ML programming.

Although several other people's monitors and assemblers worked well, they took up too much memory. Their assemblers plus my BASIC and ML code wouldn't fit.

Monitor Modifications

Finally, I received Commodore's Monitor, which is compact (860 bytes), but versatile. However, it sits down where I want BASIC code and has reset BASIC pointers to suit itself. So as it stands, it is just about worthless for my purposes.

Then I got the idea of moving it to upper memory. That way I could have lower memory for BASIC and my own ML programs. It turned out to be more of a struggle than I realized; but after several days, I finally did it.

So now I have the capability of the Monitor's starting at 1C0F or 7183 (decimal) instead of 040F or 1039 (decimal), and I can use BASIC *plus* have the Monitor display and change registers to produce, display, save and load ML code. Also, the Monitor allows me to implement the BRK instruction so I can step through a new piece of ML code without having to (necessarily) crash the system every time I make the slightest mistake.

Implementation

If you are interested in doing this yourself, follow these steps. But first you should become familiar with Commodore's Monitor so the commands won't be mysterious, and also keep in mind that this was done for an 8K PET so it won't work for a 4K version.

1. Load Commodore's Monitor as per instructions.

2. Enter the ML code in Fig. 1 using their Monitor. With the ".G 0348" command, this little program will quickly move the Monitor from the pages starting at 040F up to start at 1C0F.

3. Now go back to BASIC with the ".X" command. Type NEW, then enter the BASIC program in Fig. 2. Check it carefully and run it. It takes about 15 seconds, so be patient.

4. Now you are ready to execute the upper Monitor, so perform SYS (7183). Now you are working out of the upper Monitor if you followed the steps above correctly. Verify that all the functions work correctly.

5. Save 1C0F through 1F6F so all this won't be lost in case you made some typos. You can label it MON-7183 as a reminder where to transfer later.

6. When you go back to use BASIC, be sure to type NEW immediately!

You now have reset the BASIC pointers to allow BASIC to be used as before. Also, MON-7183 reserved the upper four pages of memory for itself and ML programs, so you have about 6140 bytes available for BASIC and ML programs. ML programs can also go from 1F6B to 1FFF.

If you want more room for ML programs, POKE 135 with a number smaller than 28. This reduces the highest location for BASIC to use. (Be certain that you perform NEW after such changes. Also, be careful about loading large BASIC programs from tape. If they go above 1C00 or 7168 decimal, the PET will show out-of-memory error.)

Now you have a Monitor and BASIC, too. From now on the MON-7183 can be loaded using BASIC's LOAD. Type it, then perform SYS(7183). I hope you find this capability as *useful* as I have. ■

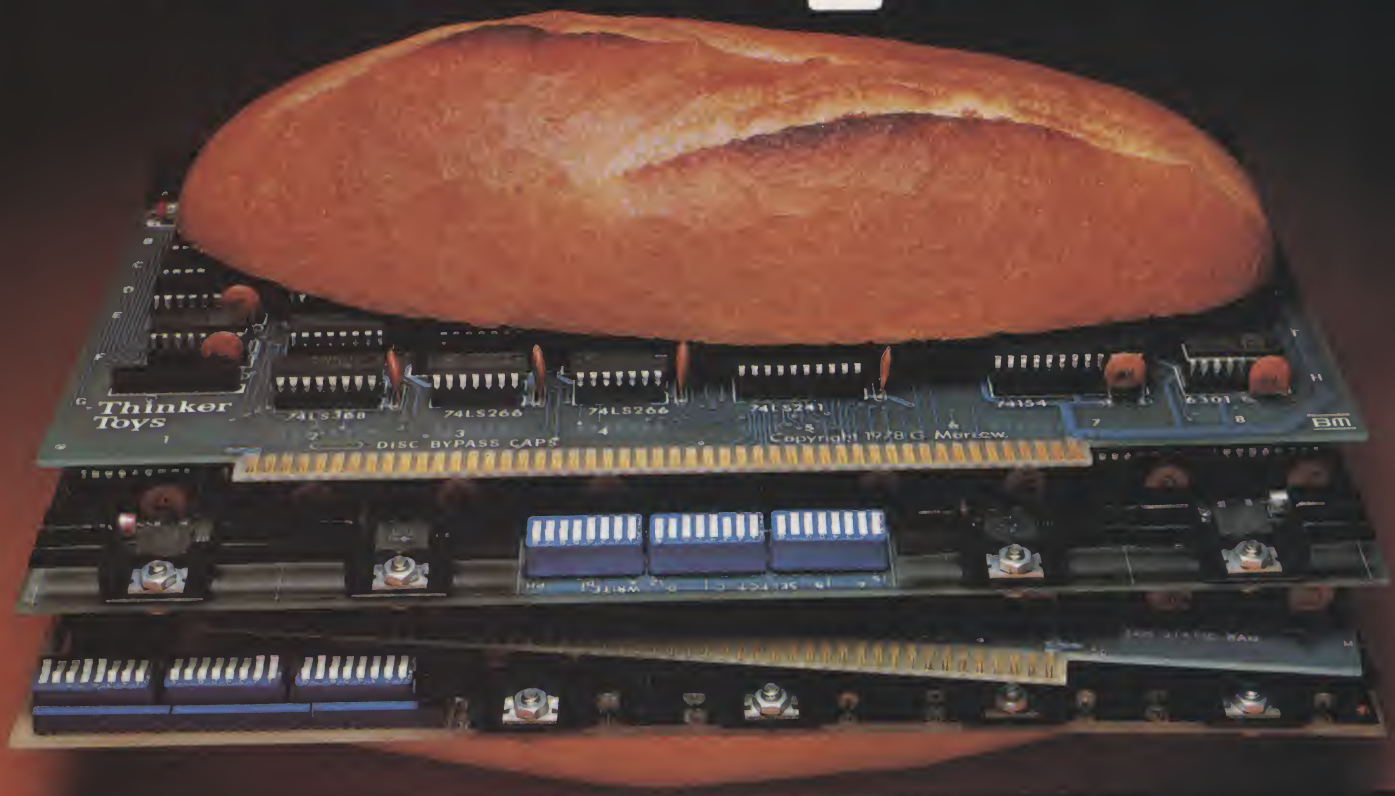
```
      0  1  2  3  4  5  6  7
0348 A0 00 A2 00 BD 00 04 9D
0350 00 1C E8 D0 F7 EE 4E 03
0358 EE 51 03 C8 C0 05 D0 EC
0360 00 4C 48 03
```

Fig. 1. ML code.

```
10  DIM NC(19)
15  FOR J = 1 TO 19: READ NC (J): NEXTJ
20  FOR I = 7183 TO 8042
25  X = PEEK (I)
30  IF X>7 THEN 100
40  IF X<4 THEN 100
50  FOR J = 1 TO 15
55  IF I = NC(J) THEN 100
60  NEXT J
70  POKE I, X + 24
100 NEXT I
105 FOR I = 7193 TO 7196: POKE I, NC(I – 7177):NEXTI
110 FOR I = 7197 TO 7200: POKE I, 234: NEXTI
115 END
200 DATA 7276, 7280, 7299, 7343, 7387, 7408
205 DATA 7418, 7472, 7547, 7587, 7725, 7731
210 DATA 7809, 7889, 7999
215 DATA 169, 28, 133, 135
```

Fig. 2. BASIC program.

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AMI's EVK Series

Part 1 of this three-part series is an introduction to a "6800 alternative."

David L. Tietz
21 Rainetta Dr., Rte. 3
Eau Claire WI 54701

A little known, seldom mentioned, second source to the Motorola 6800 family is located right in the heart of Silicon Gulch and offers some great support hardware and software for the 6800. I'm speaking, of course, of American Microsystems, Inc. Never heard of them? Well, read on, and I'll enlighten you about this slick sleeper and their goods.

The AMI people constitute one of the biggest custom MOS/LSI houses around and are responsible for, among others: the inner workings of the Pong TV tennis game, the chip that forms the brains of the Singer Athena 2000 sewing machine and the innards of some Hewlett-Packard scientific calculators. They are also very big in capacity (touch) keyboards and their associated interfacing hardware.

AMI's headquarters is in Santa Clara CA, with most of their administration, R&D and engineering departments housed there. There is some wafer fabrication on that site, as well as at another facility at Pocatello ID. Most of their assembly, however, is done in the Orient at Inchon, Korea. This makes AMI's S6800 family of circuits generally more attractive from a cost viewpoint than Motorola's M6800 family, even though they carry the same specs. AMI also has some 6800 circuits Motorola doesn't offer.

AMI's Offerings

AMI has its own micro, called the S2000. This is a mask programmable 4-bit machine aimed at the OEM user. It's basically appliance-control oriented, with an internal touch keyboard interface and direct readout drive capability.

For the 6800, AMI has a full-blown development system called the MDC-100. This fully supports the 6800 and S2000 families with its hardware and software. The price tag on this unit with its associated floppies, CRT terminal, line printer, etc., runs into the thousands of dollars.

Also offered is a low-cost single-board computer line, called the EVK series. These are headed up by the EVK 300, which will form the basis for this article. This computer is a 100 percent functional development system (lacking only a power supply and terminal) with the ability to develop, document and prove out software, test hardware, burn EPROMs and implement a stand-alone microcomputer system. It also provides a bus interface for expansion of memory or I/O.

The reason for AMI's obscurity among hobbyists to date is that none of their products (the EVKs included) were designed for mass retail sales. As I pointed out, AMI's main business is making custom LSI chips, and the EVK series was designed to drum up business.

With an EVK 300, a company can begin serious microcomputer design (which is exactly what my firm did). They can breadboard a new product idea quickly, inexpensively and, most important, confidentially, then prove it out. Once the breadboard is complete, said company could approach AMI for a custom chip based on the EVK implementation. AMI engineers could see what is wanted in an actual model. To jump right in for a custom chip, on the other hand, would require detailed specs, full disclosure, lots of correspondence and time before the product idea could come to life.

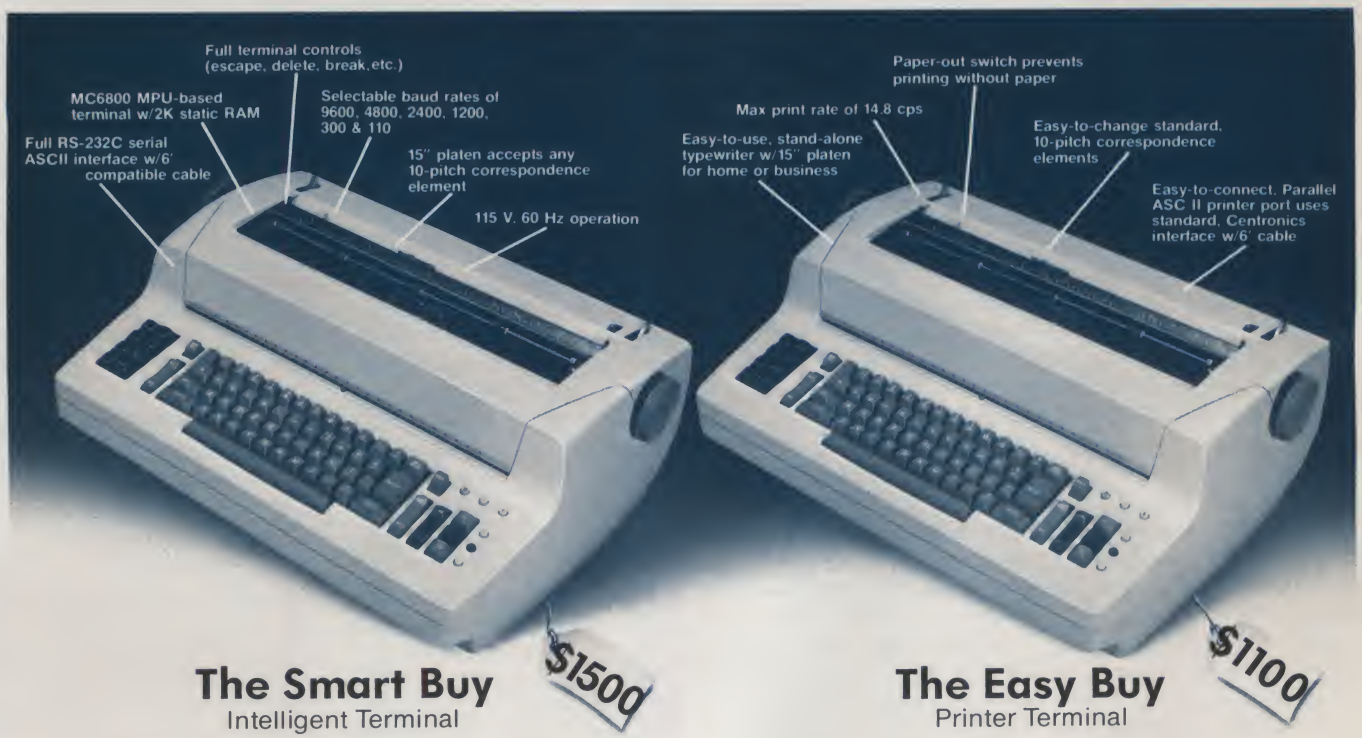
AMI will work either way, of course, but I feel, especially for a small company with limited resources, the do-it-yourself method is best. So, if the EVKs were designed for company R&D labs, why am I bringing them up in a hobby magazine?

Recent price cuts by AMI and some of their distributors (in some cases, cuts greater than half of the original $765 price of the EVK 300) should spark some interest from serious 6800 hobbyists. One man, with a good idea and an EVK system, can make a product. The system is



(Photo courtesy of AMI)

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very "outside world" oriented, with 58 control lines that allow almost limitless applications. Bring in keypads, A/Ds, switches, output to readouts, printers and relays; buy a low-cost system in the EVK series; burn EPROMs on your 300; and you've got a product. Well, maybe there would be some other details, but I'm sure you get the idea.

The Boards

OK, I put enough "sell" in this article, now on with the technical stuff. There are five versions in the series, with the bottom of the line, the EVK 98, being nothing more than the printed circuit board. All versions use the same 10½ × 12 inch PC board, and upgrading is relatively easy.

The next step up is the EVK 99, which is the PC board plus a chip set. The chips supplied are: one S6800 MPU, one S6850 ACIA, one S6820 PIA, four S6810 RAMs and AMI's Monitor, PROTO, contained in one S6831 2K ROM. The EVK99 can be be built up into a working microcomputer with most components that are generally found in a hobbyist's junk box.

The next step up is the EVK 100, which is that working computer with AMI-supplied TTL and other support chips. The complete kit, with an on-board EPROM programmer, one blank S6834 EPROM and no less than three S6820 PIAs, is the EVK 200.

The top of the line is the factory-assembled-and-tested EVK 300, which includes the full complement of four EPROMs and a Tiny BASIC interpreter on paper tape. AMI also includes sockets for every IC on the board.

The 512-byte S6834 EPROMs supplied are, to my knowledge, unique to AMI. 2K bytes of memory are set aside for them, and four IC sockets on the EVK 300 allow the EPROMs to be plugged right in and immediately accessed. This more than makes up for the scanty 1K RAM residing on the board, as often used subroutines can be blown into EPROM and reside permanently in memory.

Series Software

Software for the EVK series boards is probably unlike any you have ever seen. PROTO contains a MIKBUG-like Register Dump command, but there the similarity ends. Programs can be loaded from paper tape at the memory location specified in the paper tape or with a memory offset that will place the tape contents at some other area of memory. Similarly, data from memory can be punched to tape with an offset. The offset value is a four-character hexadecimal number. The punch *from* and *to* limits are entered on the terminal directly after the command, so there's no need for setting memory pointers.

There is an End command, which, after a paper tape has been punched, will terminate it with an "S9" and punch a trailer tape. The Move Data command will move a block of memory from one range of RAM to another range of RAM. The Set command loads memory from the keyboard directly in hex with a space separator between bytes. Similarly, the Display Memory command prints the contents of memory up to 16 bytes per line with an automatic CR, LF and current address display.

The Go command merely requires that you enter the starting address of the program you wish to execute immediately following it. The three EPROM programming commands are Burn, Verify and Input. The Input command aids in making minor changes to a programmed EPROM.

There is an area of memory in PROTO that AMI also offers as a separate ROM. This includes many general-purpose subroutines that the user may wish to call on a system of his own. Some of the subroutines allow pushing all of the MPU's registers onto the stack, popping all registers from the stack, validating alphanumeric characters, adding, subtracting and multiplying binary numbers, and communicating with the terminal, among others. The use of these subroutines can save the user a lot of memory in programming.

Perhaps the most convenient of the EVK software support is AMI's MA/D ROM. This contains a microassembler/disassembler, which will take standard 6800 mnemonics and translate them into machine code at the location specified by the user. It will also disassemble existent codes into the mnemonics and data for documentation or debugging. I have found this to be extremely useful for writing short test programs and in debugging current programs.

AMI's Tiny BASIC is a 2K subset of the original Dartmouth BASIC. It is designed to be loaded into the EVK by paper tape and be blown onto the four EPROMs allowed in EVK's memory. Tiny BASIC does have a USR function, which will allow the operator to make use of the EVK's tremendous I/O capabilities.

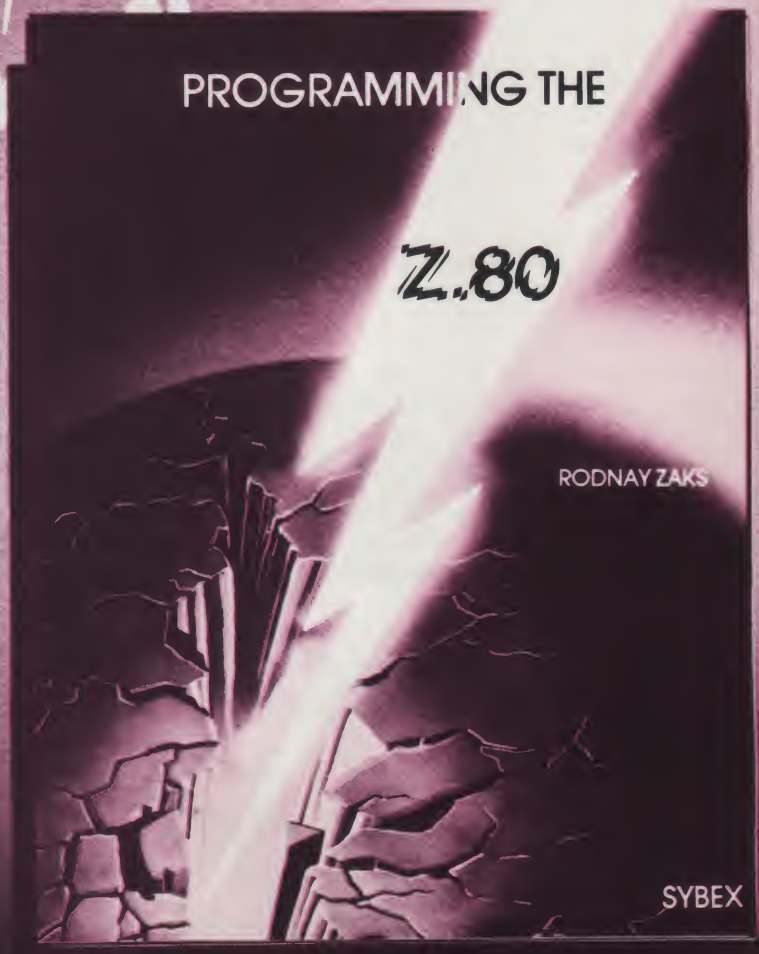
Certain support cards, card cages and other EVK accessories are available through some hobby shops. I have seen a brochure featuring a 16K RAM card that can be built up 4K at a time. I feel that when you use the Tiny BASIC the RAM should be expanded to at least 4K.

That concludes my brief introduction to AMI's EVK series. In part 2 I'll go into detail on AMI's hardware; part 3 will describe software. ■



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To an outsider, the world of microcomputers is as uncharted as the oceans were in ancient times. It is unstructured, growing and changing at a fantastic rate, and it offers both real effectiveness and beautiful-looking false promises to attract the buyer who may not be able, initially, to tell substance from sham, or achievement from incompetence. All of these things exist in this new computer world, just as they did for that ancient traveler.

I feel as Ulysses must have felt, long ago, as he moved inexorably into new and unpredictable adventures, trying to find his way home from the wars. My journey, however, is in the field of business—both as a businessman and as a teacher of business administration in a field where the microcomputer is just beginning to make a meaningful appearance.

Over the last 18 months at my company, where we do design engineering, I have considered introducing microcomputers and microcomputer-based systems into our technical and business operations; and at the college where I teach accounting, I have looked into the possibility of developing computerized accounting system models for application to small start-up businesses. I have had more success satisfying my technical need than the business needs, and it is because I don't fully understand why this is so that I am writing this article.

I need several forms of help. First, I have two small businesses that could benefit from computerized general ledger systems, as well as several entrepreneurially inclined friends who could use them, too. Second, as a part-time teacher of business administration subjects, particularly accounting, I think my students could benefit from knowing about and being exposed to microcomputer-based management control and accounting systems. And third, as an engineering designer at my business, I could use a "sidekick" computer to complement the work of some dedicated computing equipment that is embodied in our key production machinery. That's where I am now. Let me tell you about my travels in the world of computers, and microcomputers in particular, for it has been both a frustrating and a rewarding odyssey.

Making the Initial Contacts

We first realized that we might be able to use a computer at work about two years ago when the demand for our product—precision-engraved artwork and engineering graphics—outstripped our capacity to produce. We could hire no capable people to help us out, and one of our customers began making increasing and effective use of a computer-controlled drafting and scribing machine to take over some of the work we had previously supplied.

At the same time that we began exploring this application, our bookkeeper/controller, who serves several small firms on a part-time basis, began to be overworked and wondered if a computer could contribute to make her time more productive.

Our initial look at computers began cold with calls to DEC, Data General and, with some trepidation, to IBM. We called DEC because they are a customer of ours, Data General because they are also in the area and IBM mainly out of curiosity.

Nobody was particularly helpful. Our main problem was that we didn't really know what questions to ask and we had no prior computer experience. It took us about two frustrating months to learn what makes obvious sense to us now, i.e., computer salesmen are not equipped/programmed to deal with first-time users of small systems, because they are operating on a different intellectual plane and because missionary sales (to first-time users) take more time, effort, backup and expertise than selling replacement or additional equipment. The salesmen, too, must have been frustrated by our lack of knowledge—we were certainly frustrated by receiving technical data that was beyond our comprehension, coupled with reassurances that everything would turn out just fine if we bought brand X.

Our contacts with these computer firms, however, did reveal to us some things well known to the mini-microcomputer trade, but not well enough known to the general public or the general business community. Our contacts with DEC and Data General revealed a reluctance to deal with small end-users and spotlighted for us a large group of so-called OEM systems integrators and programming houses that swallowed up big bucks over and above the hardware cost and retained control over programs with horrendous-looking software-licensing legal agreements. The number and variety of these firms and the almost total lack of ability for a neophyte to check them out left us very uncomfortable.

IBM showed us more hardware than anyone else—complete with in-plant demos and an offer (refused) of free use of the machine for a week. As I recall, we refused this offer more because the sales people from IBM had failed to demonstrate anything of use to us in two visits and had tried to show us how wonderful it would be to have their dual language machine—APL for our engineering applications and BASIC for accounting—even though we only knew some FORTRAN and nothing else.

Through their demonstrations, however, IBM did contrib-

ute a useful "feel" for machine and peripheral sizes, configurations, interfacing and the extreme modularity of small machines. Even their price was reachable, though by no means the most cost effective. At this point, because we could not really connect with anyone, we almost backed off the whole idea of computer applications.

The Right Match—Technically

Shortly after these encounters, and as a result of a customer inquiry on another matter, we contacted a machinery supplier who also happened to be a DEC OEM for computer control of drafting and scribing machines. This firm offered a German machine, controlled by a dedicated PDP-8, that looked promising for our engineering graphics and some of our production work. They were able to demonstrate the machine using our materials and our processes in such a way that we could estimate specific productivity and quality improvements compared with the way we were then operating. After some serious thought and an encouraging talk with our banker, we purchased this firm's computer-controlled machine at about the price that two of our earlier contacts had quoted for their computers *alone*.

In its first months of operation, this machine has proven to be an effective production tool as well as a surprisingly effective marketing tool, since, due to its novelty, many of our customers want to view this machine and try some new work on it.

This machine and its supplier have also taught us a few things. First, a competent OEM is happy to give references, which are a source of valuable information. We checked out five or six on a list of eight customers that were supplied and learned that, even though the supplier was well thought of, we could expect start-up problems. We were assured that the supplier could and would willingly and effectively cope with these problems, but that we should allow several weeks to a month of sometimes frustrating work before fully reliable operation would be achieved.

As it turned out, we were both lucky and frustrated. The machine was balky at first due to an on-board power supply problem that took about two weeks of tech rep visits to find and correct, but this was the only substantial hardware problem. The software has turned out to be just what the doctor ordered, although six to eight months of using it have revealed some more desirable peripherals we could use.

Programming the machine is by canned, punched paper-tape programs that provide an interactive mode of operation with the designer or draftsman who uses the machine. The programs have provided us with more computer-related lessons. First, computers can drop parts of a program without telling. Second, some program configurations rapidly change, and the program house that supplied it—unless it has unusually good records—is not always sure which version you have.

Third, peripherals and accessories, like programs, are sometimes wired up to special configurations, and the OEM vendor may not know exactly which version you have. This problem came to light when a solenoid in a peripheral overheated and a replacement was shipped out by the OEM. Upon receipt, we found that its wiring was not the same as the failed solenoid—one was for US use, the other for overseas—and a soldering iron and schematics had to come out to effect the replacement.

The last and most important positive lesson, however, has been to see how a competent OEM can reduce the purchase price paid for this type of equipment. All in all, despite a few drawbacks, we are delighted with and proud of our new machine. Its existence has attracted new customers, and our productivity and quality have improved.

> **The only software that I find is high priced, tightly controlled by license or inextricably wedded to the hardware so that acquisition is expensive, use is limited and modification is discouraged.**

And, if I were to compare the start-up frustrations of the machine with the ongoing frustrations of breaking in a typical new human employee, the machine would win hands down! It is more predictable, much more accurate, doesn't get paid overtime, never leaves the office, needs no vacations (we'll give it a few sick days) and—when properly dealt with—never makes the same mistake twice! The journey, so far, for our engineering application has a happy ending—but what of our business needs?

Business Application—A Frustrating Trip

This part of the journey has been much more frustrating. I've described our encounters with the big hardware suppliers. It was as a result of these that I learned of the growing home computer efforts and decided to check out the possibilities here. My first stop was at a retail computer store in the Boston area. Aside from picking up my first copy of *Kilobaud* there, I left this visit and others to similar stores frustrated because of the wide gaps between technical promise and effective business application.

Most of the stores were clean and neat, but the marketing approach was strictly "take it or leave . . . ." Let me give you a couple of examples. I had to ask questions of a salesman who was trying to unpack a well-wrapped printer:

Me: "Hi, could you tell me how to get started . . . ."
Salesman: "Hey, Mac, grab an end; they packed this one differently this time."
Enter Computer Jock (a customer) to salesman: "Oh, George, have you got a Motorola ZX-H492A?"
Salesman: "Over in the cabinet, Jock. Leave the money on the register. Have you seen our super new Galactic Conflict game?"
Jock: "Heard about it. I'll pick up a tape next week." (leaves)
Salesman: "Got a penknife, Mac? We'll have to cut it open, I guess. Say, what was it you were after?"
Me: "Some help on possible business applications. What's available, anyway?"
Salesman: "Oh, not much yet, but a lot of people are working on it. There are some books over in the rack, but the programs are all tailored for the Super Comp II, and some of the programs are just plain wrong."
Me: "Oh, well, I guess I'd better come back later."

And then, there was another time I was turned over to a manufacturing representative who happened to be in the store setting up a display:

Rep: "Hello, would you like to see our new text-processing machines?"
Me: "Well . . . uh, I'll take a look at it, but I'm really interested in accounting systems."
Rep: "Good, how many letters does your company write in a week?"

Me: "About three or four . . . uh, but we do process a number of invoices and other forms."
Rep: "Can't handle them yet. Do you write technical reports?"
Me: "Not very often. Can your machine process numbers at all? It looks impressive."
Rep: "Give us a couple more months; we're working on a program that might help you."

These types of conversations have taken place many times for me in many stores, and I am frustrated for several reasons. First, I think the hardware available can be made to do the job that I need done. Second, prices are rapidly becoming more favorable. Third, peripherals are increasing the utility and convenience of the machines, but it seems that few, if any, are effectively programming these units for much more than TV games.

I have seen ads in the business publications for business-programmed micros, and I have seen them at an office trade show, but these offerings are unusually "bundled," i.e., the hardware and software are inseparable, and the programming is not able to be changed to solve engineering problems one time and do accounting or word processing the next.

I'm looking for a reliable machine to (1) introduce a set of interacting, modular accounting packages for part of the work week, (2) set up to solve engineering drafting problems (trigonometry/coordinate geometry) part time and, perhaps, (3) tackle some word-processing applications in still a third block of time. I would need source code or at least a means of modifying a packaged program as well as easily understandable instructions for executing the programmed portions that I purchased.

I suspect that any 12- or 16-bit micro with sufficient memory would be able to handle this work easily and that the popular 8-bit systems would work well, too, though somewhat slower. The only software that I find, however, is high priced, tightly controlled by license or inextricably wedded to the hardware so that acquisition is expensive, use is limited and modification is discouraged.

Maybe I'll just have to keep dropping into the computer stores, and perhaps I should join one of the computer hobby clubs (although I'm afraid I'd spend a lot of time working with TV games if I did). What should I do next?

I am specifically looking for a modular accounting program that can set up general ledger and, I hope, subsidiary ledger accounts that can store and summarize transactions and generate trial balances. The program should have safeguards, interlocks and record-keeping routines to protect the business records, and it should be modular to permit adaptations to various types of business endeavors.

Conclusion

While I have knocked computer sales and programming people in this article, I should say that accountants are also not entirely free from blame. Several years of teaching the subject, reading and practicing it for various employers has taught me that accountants will readily deal with optimizing the treatment of a single business transaction or designing a data input or output system, but that when it comes to setting up a complete new system, they often stop cold in their tracks. This appears to be even more true when the creation of a new system using computers is contemplated. Accounting literature is full of articles on auditing, tax laws, mergers, depreciation, inventory valuation, etc., but when it comes to bolting up a new system, you are on your own.

So you out there, let me hear from you if you have any reasonably priced modular programs for general ledger accounting, coordinate geometry or word processing. ■

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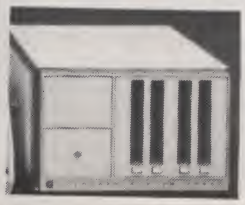
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With these five disks, I can turn your TRS-80 into a serious computer.

My name is Irwin Taranto, and I know what I'm talking about.

I've been making computers work ever since they had vacuum tubes in them, and I've put the first computer into more than 300 different businesses.

Over the years, I've learned a few things.

For instance, I've learned that the new microcomputers like the TRS-80 are really elegant pieces of hardware. The price is deceiving. Given the right programs, they can jump through hoops.

But finding the right programs isn't all that easy. You can flip through the pages of this magazine and find 50 ads for TRS-80 programs. Granted, a good many of them are for fun and games, but you can still find quite a few offering business programs.

They aren't like mine, though.

Four of these are the genuine Osborne & Associates systems, originally designed for the $30,000 Wang computer. I've made a few minor modifications on them, and now they work on a $4000 TRS-80. The fifth program is one I added myself.

Here's what's on each disk:

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These programs are marvels of efficiency. They're fully-documented, and you can buy the books locally or from me. On the Osborne programs, my contribution was simply this: I made them work on the TRS-80, and if you buy them from me, I'll make them work for you.

If you're skeptical on that point, call the number below and we'll give you the names of some of the people who've already bought all over the world. Then you can call them up and hear what they have to say.

These programs only cost $99.95 each. (The Cash Journal option on the General Ledger adds another $50.) For that you get the disk, all the instructions you need, and my telephone number. If you call, we answer all your questions and make sure everything's working smoothly. If your question's tough enough, I'll talk to you personally.

Because, as I said, I plan to turn that TRS-80 of yours into a serious computer.

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Apple's Documentation Strikes Again

Despite some disappointments, Ken essentially rates this software package favorably.

I recently was fortunate enough to purchase one of the first Programmer's Aid ROMs in the Los Angeles area for my Apple II computer. Although early 1978 price lists included the device, and the January 1978 edition of the Apple reference manual refers to its high-resolution graphics routines, I had given up any hope of seeing it. Thus, its unexpected arrival was an early Christmas present.

The device lists for $50. For this price, you get a package consisting of a single ROM and a 96-page manual. Apple is continuing the same box-style with the Programmer's Aid that they initiated in marketing their cassette programs. The manual is in the same style and format as the earlier Integer BASIC and Applesoft II manuals, with examples highlighted in easy-to-read green ink.

Reading the Manual

The manual contains a separate chapter on each of the eight routines contained on the ROM chip. Two appendices that contain complete source assembly listings for each of the routines and an easy-to-use summary of the commands available with the Programmer's Aid are included. The latter is particularly useful, since most of the routines are accessed through BASIC CALL commands to addresses in the −10500 range. Even after two months of practice, I still can't keep the addresses straight.

The first flaw I found (and it's a minor one) is the binding. The book is stapled together and refuses to lie flat. I know the plastic spines used in previous Apple manuals are more expensive, but they result in a much more useful book.

The second flaw is by no means minor. The manual completely omits any reference to two commands that are available in the Hi-Resolution Graphics routines. This is doubly inexcusable since they are commands that do not exist in the cassette version of the Hi-Resolution Graphics package.

The ROM itself plugs into one of the empty sockets in row F, marked ROM-D0. The manual contains complete instructions for installing the ROM, and even the beginner should have no problem with it. The chip contains eight separate routines: Renumber, Append, Tape Verify (BASIC), Tape Verify (machine code), Relocate, RAM Test, Music and Hi-Resolution Graphics. I was disappointed to learn that the routines are not usable with Applesoft II. Three of the routines are designed to manipulate Integer BASIC programs, and the others make use of the same memory locations that Applesoft II uses for the beginning of program storage.

The Routines

Renumber provides simple and fast renumbering of all or any part of a BASIC program. The user has complete control over the lines to be renumbered and the beginning and incremental values of the new numbering sequence. Unlike some similar programs I've seen, the routine does not become confused if you inadvertently give it nonexistent line numbers for the beginning or ending of the block to be renumbered. The program simply proceeds to renumber all lines falling within the given range of values.

About the only limitation to its use is that it will not change the sequence of a block of lines. Thus, a block of lines at the beginning of the program cannot be moved to the end. However, with the combined use of Renumber and Append, it is possible, though tedious, to accomplish this. You must break the program up into blocks, renumber them and then append them in the desired order.

I'm not really sure why Apple bothered to include the Append routine. It is only a few keystrokes shorter than the usual set of PEEKs and POKEs that accomplishes the same thing. Furthermore, the Append routine will not work with the Disk II system and gives an error if the blocks are not loaded in descending order of line numbers. The latter restriction requires renumbering of each block separately, before they are appended to each other.

Tape Verify (BASIC) and Tape Verify (machine code) will be most appreciated by those Apple II owners who do not have a Disk II system. Without these routines, every time you attempt to record a program on tape, you keep your fingers crossed that the recorder is recording something that the computer will be able to reload. A loose plug, a dirty recorder head or a mis-adjusted volume control can turn hours of effort into meaningless noise on your tape.

With the two Verify routines, you can test the tape you have just saved against the contents of the computer's memory. If you get an error at this point, you have not lost or altered your program and can keep trying until you get a copy that you *know* will be loadable in the future.

The Relocate routine is really designed for the fairly advanced programmer who regularly works with machine-language programs. Although short machine-code programs are often relocatable by simply moving them to another address with the Apple monitor's Move command, most such programs will contain a large quantity of absolutely addressed JMPs and JSRs. Normally, these must all be located and manually altered after the program has been moved.

The Relocate command takes care of this task automatically. The instructions in the manual are complete enough that anyone doing the type of programming work that requires this capability will have no problem using the routine.

The capability of relocating machine-language code leads to a variety of interesting possibilites. For example, as pointed out in the manual, the monitor itself may be relocated to run in RAM. Of course, once this is done, the monitor can be modified to suit one's individual needs.

The RAM Test routine is another routine of limited usefulness; I feel it could have been left out. Perhaps I have been spoiled by the high reliability of my Apple, but the need for such a routine does not seem to be sufficient to justify the waste of precious ROM space.

The routine itself is convenient—it tests for both simple memory errors and dynamic memory errors, in which the act of writing a number to one memory address causes the contents of another address to change. Most RAM test programs do not perform the latter test. Furthermore, the routine is capable of automatically testing for intermittent failures.

At first I was unimpressed with the Music routine. It provides a method of obtaining tones from the Apple's speaker without having to include a machine-language subroutine in each of your programs. Pitch, timbre and note length are all under program control. The pitch steps are designed to approximate a musical scale, four chromatic octaves in length.

When I started using the routine, I found that it rapidly became one of my favorites in the package. Because of its association with the Apple's error messages, I have grown to hate the bell tone that the Apple uses. Thus, even where a programming situation called for it, I was in the habit of omitting the tone as an audio prompt. Now, with the Programmer's Aid, I include short-note sequences in programs to accompany or replace prompt messages. This results in programs that are much more pleasant to work with.

The Hi-Resolution Graphics routine is essentially the same group of capabilities previously available on cassette for Integer BASIC and included in the Applesoft II language. The manual section of the Hi-Resolution Graphics is the largest in the book.

When I read it I found that there was no reference to the XDRAW command, which I had grown to know and love in Applesoft II. I assumed that in fitting the package onto a single ROM chip, some compromises had been made, and this command had been one of the losers. For those unfamiliar with the command, it allows a shape to be drawn and then erased without altering the background. Thus, the Enterprise can pursue the Klingon battle cruiser across a background of stars without erasing the stars it passes in front of.

While trying to find a way to obtain the same capability, I was reading through the source assembly listings in the manual. Much to my surprise (and evidently that of the manual's author), I found both XDRAW and XDRAW1 alive and well in the listings. A quick check with my computer confirmed their existence. Perhaps Apple simply wants to make sure we are reading every single page of their manuals. The two commands are exercised in the same way as all other commands in the Hi-Resolution routine. Define the variables XDRAW = −11452 and XDRAW1 = −11449 in the early part of your program. Then whenever you need them, use CALL XDRAW or CALL XDRAW1.

After playing with the XDRAW command for a while, and making some inquiries, I found the apparent reason for the omission. Apparently there is an error in the programming of the chip. The ROMs were designed and burned before the manuals were printed, so Apple simply chose to omit any reference (except for the program listing) to the XDRAW function. The bug itself only shows up in certain situations. With some combinations of rotation, scale and color, the command will not completely erase a figure it has drawn. on page 73, line 477 of the manual, the correct listing should be:

```
D2E1 20 C1 D0 477 JSR LRUDX1
```

Since you can't change the ROM, the only way to make the correction is by relocating the entire graphics package to RAM.

Two new commands in this package are DRAW1 and XDRAW1. Although primarily designed to link shapes together, they have a second useful capability. When used in place of the DRAW command, DRAW1 returns a "collision count" that indicates whether the last drawn shape has touched or overlapped a previous shape. XDRAW1 is similar. These will be useful in games or interactive graphic displays.

The other Hi-Resolution commands are the same as those found in the cassette version and allow the plotting of points and lines in the high-resolution mode. The primary advantage with these is that they no longer have to be loaded every time they are used.

The manual section on the Hi-Resolution Graphics clears up some of the confusion about shape tables created by the Apple reference manual. The manual insists on repeating the confusing explanation of the method of generating a shape table, using arrays of little arrows arranged into boxes, rather than approaching the task as a simple problem in converting hexadecimal numbers to octal. However, the memory usage information should help prevent collisions between shape tables and other parts of your program.

Conclusion

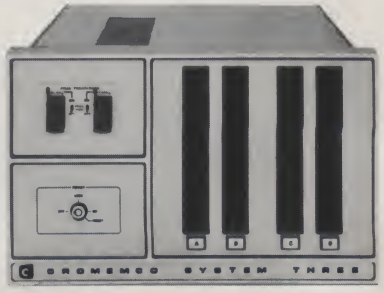
The Programmer's Aid package is a welcome addition to the Apple II's capabilities. In my experience with it, the Renumber and Relocate routines alone have been worth the $50 price tag. I'm sure that users of tape-based systems will have the same reaction to the Tape Verify commands. The Hi-Resolution Graphics commands and the Music routine will be most useful to programmers designing interactive and game programs.

My only real criticism of the package (aside from the omissions from the manual) is the inclusion of the Append and RAM Test routines at the expense of other more useful capabilities. I would have prefered to see a routine to list all variables and/or all line references used in a program. I know Apple has developed such routines, and it would be nice to see them generally available. ■

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Caps Lock, Not Shift Lock

Some keyboards are a pain in the shift finger. This caps-lock circuit brings relief.

Most upper/lowercase keyboards incorporate a shift lock for typing capitals. This has the annoying property that if you're typing mixed capitals and numbers, you have to keep shifting and unshifting. Other keyboards, such as the one provided with my SWTP TV Typewriter II, have an uppercase switch that acts almost like an alphabetic caps lock, except that it affects several additional characters as well, notably turning rubout into underscore.

The Circuit

This problem requires a true caps-lock switch, one that shifts only alphabetic characters. When I finally got sick enough of shifting and unshifting in my text editing, I built this circuit (shown in Fig. 1), which is interposed between the keyboard and the TVT. The circuit is a simple combinatorial circuit that controls bit 6 going to the TVT as a function of the caps-lock switch and the type of character being sent.

The signals are as follows. A1-7 is the character coming from the keyboard. B1-7 is the character going to the TVT. ALPHA is an internal signal indicating that A1-7 is an alphabetic character. A6 indicates lowercase if the character is alphabetic. LOCK indicates that the caps-lock switch is on. The character is passed straight through except for B6, which is computed according to the truth table in Fig. 2.

The truth table illustrates that B6 = $\overline{\text{ALPHA}}$ A6 + $\overline{\text{LOCK}}$ ALPHA A6. In English, this means that B6 is on when A1-7 is not alphabetic and A6 is on, or when A1-7 is alphabetic and A6 is on and LOCK is off. In gates this is shown in Fig. 3.

The next problem is to compute ALPHA. A1-7 is alphabetic whenever A7 is on and it is not one of the special characters like @, _, etc. To detect these special characters, wide NAND gates, 7430 and 7410, are used. The circuit is shown in Fig. 4. Note the unused inputs of the 8-wide NAND gates being tied high to a grounded inverter.

LOCK	ALPHA	A6	B6
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

Fig. 2.

The only remaining gating is some inverting shown in Fig. 5.

The circuit is laid out using sockets on a 1½ by 3 inch board as shown in Fig. 1. The next step is to create the wire list (including power and jack connections) and to wire-wrap it. I used AWG 26 because of the cable lengths involved and the supply currents.

After wrapping, the circuit is buzzed out and tested for shorts. Next the chips go in, and power is applied momentarily to check for frying parts. Finally, the circuit is static-tested by typing various keys and measuring the logic signals with a voltmeter. These procedures should locate all wiring errors.

Different keyboards may require small variations on this circuit. For example, I now have a surplus Microswitch Hall Effect keyboard (Herbach & Rademan, about $50) that's a real honey. However, its shift key works in reverse on letters, and its code is inverted. These are easily fixed by rearranging a few wires in the circuit. ■

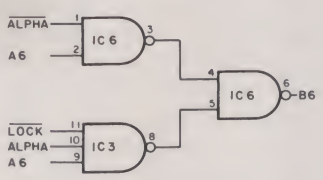


Fig. 3.

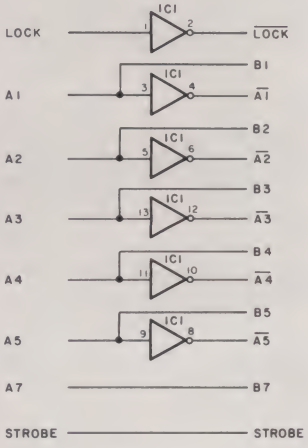


Fig. 4.

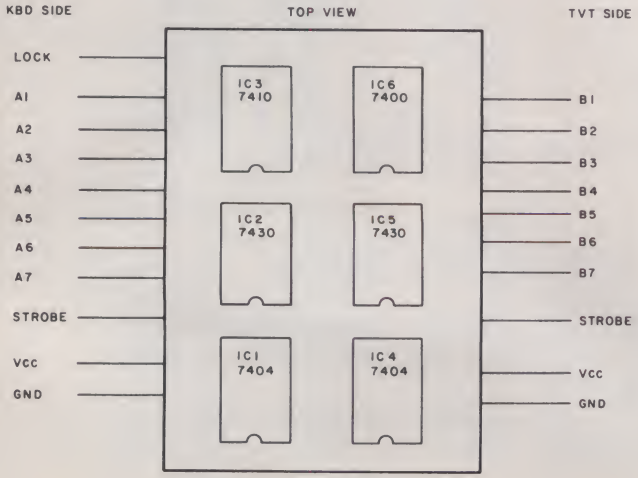


Fig. 1.

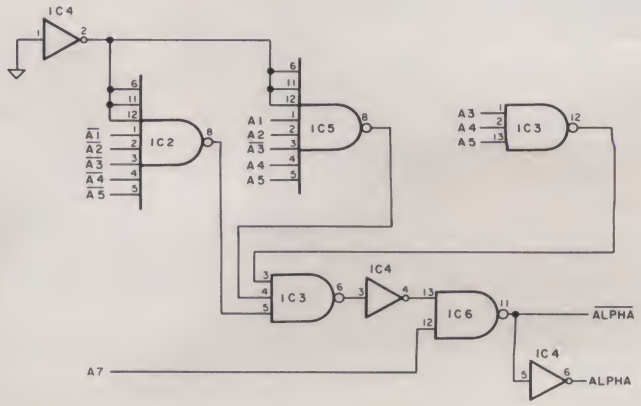
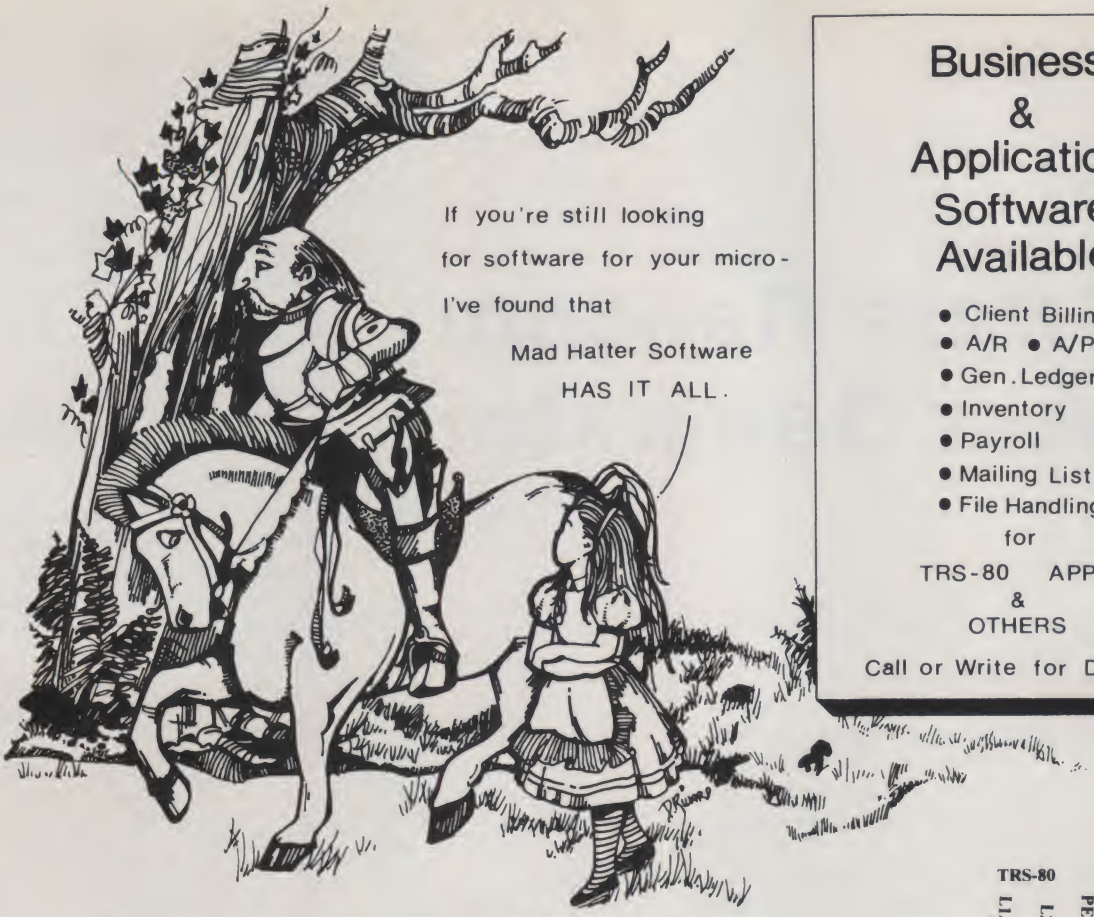


Fig. 5.



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Hardware Random Number Generator

Software techniques may be less than totally random. Try hardware.

When you catch a card dealer stacking the deck, drastic measures are in order. In my case I was not about to shoot holes in my Intel 8080-based microcomputer opponent, but the practice bridge hands he was dealing were beginning to repeat themselves too frequently.

Quite often the hardware I build generates random numbers when it is not supposed to, so I decided on a hardware solution to the problem. The oscillator shown on the schematic (Fig. 2) is my favorite circuit due to its simplicity. Three stages of a 7404 connected as a phase shift oscillator make

```
;  RANDOM NUMBER GENERATOR
;  ENTER WITH (H,L) POINTING TO NUMBER
;  EXITS WITH A 16 BIT RANDOM NUMBER IN NUMBER AND NUMBER+1
RANDM:  MVI   A,00
RAND1:  DCR   A          ;  DELAY ONE
        JNZ   RAND1
        IN    ADRS       ;  GET A NUMBER
        MOV   M,A        ;  STORE IT
        INX   H          ;  UP INDEX
        MVI   A,00
RAND2:  DCR   A          ;  DELAY AGAIN
        JNZ   RAND2
        IN    ADRS       ;  READ AGAIN
        MOV   M,A        ;  INTO NEXT NUMBER
        RET              ;  ALL DONE
```

Fig. 1. Random subroutine.

The Dealer subroutine in my bridge playing program made use of a software random number generator supplied by Intel's users group. As with all software generators, its output is not truly random, and the length of the sequence of numbers generated is just too short. Dealer needs too many random numbers to shuffle 52 cards and hands were beginning to repeat themselves.

use of their own transit time rather than external Rs and Cs to produce an output at something over 30 MHz. Slowing things down with the 1000 picofarad cap results in a frequency that the 74161 counters are happier with.

It would not appear that the outputs of the 74161s would produce a random number, but if the intervals at which the numbers are read out is long compared to the time it takes for the count to sequence through 256 steps, and if the oscillator is not in synchronism with the CPU clock, the randomness is as true as any other method can produce.

The address decoder partially shown on the schematic is given for the sake of completeness. Different systems will have their own methods for producing I/O port addresses. The eight inputs to the 7430 would be connected directly or through inverters to the eight low order bits of the address bus to decode the input port address assigned to the random number generator. The low true $\overline{\text{ADRS}}$ signal is applied to the count inhibit pins of the 74161 counters to prevent them from changing state during a read operation. The $\overline{\text{INPUT}}$ and $\overline{\text{DIEN}}$ (data in enable) terms are characteristic of the 8080 system. Other processors have other signals to enable an I/O read operation. In any case, these terms are combined with the address decode to produce an enable signal for the 8T97 Tri-state buffers[1]. This gates the present count from the 74161s onto the data bus. And Dealer hands us another card.

To absolutely insure that the counters sequence through many cycles between subsequent random number fetches, Random subroutine (Fig. 1) includes a millisecond or so of delay between reads.

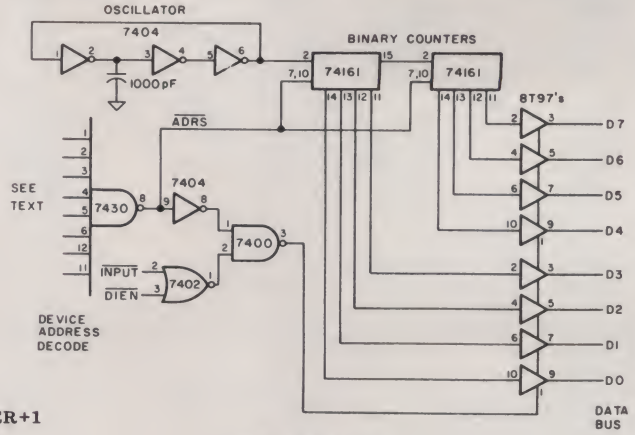


Fig. 2. Schematic.

This is undoubtedly overkill, but adds to confidence in the system. The software routine which got caught cheating produced a 16-bit number, stored in two memory locations pointed to by the (H,L) register pair, so Random duplicates this and includes two reads each time it is called.

In addition to the 16-bit numbers, this project has produced harmony in the computer shack, as I can no longer accuse my opponent of cheating. How come he still beats me? ■

Reference

[1] Molnar, John: "Three-State Logic," *Kilobaud* #4, April, 1977, p. 106.

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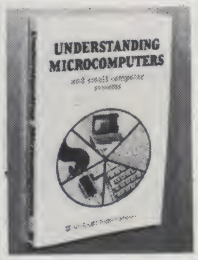
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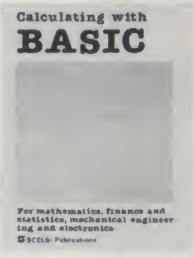
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Bit Rate Clocks for Your Serial Interface

With applications for UARTS abounding, this examination of alternative methods for generating the needed clock frequencies for all those UARTs should prove useful.

R. R. Derynck
#28, 336 Rundlehill Dr. NE
Calgary, Alberta
Canada T1Y 2Y2

The UART, or universal asynchronous receiver/transmitter, has become a popular device for implementing serial data communications circuits between computers and terminals. This LSI device is both inexpensive and convenient, providing serial-to-parallel and parallel-to-serial conversions, error checking and selectable character lengths all in one 40-pin IC package.

Whenever a UART is used, it is necessary to provide a clock signal to determine the data rate or bit rate of the serial data transmitted or received by the UART. The AY5-1013 and similar UARTs[1] (see Table 1) require a clock signal 16 times (16X) the desired bit rate. For example, if the UART is to operate at a data rate of 110 bits per second (bps), the clock frequency must be 16 × 110, or 1760 Hz.

There are two clock inputs to the UART, one for the receive section called receiver clock or RCP (pin 17) and one for the transmit section called transmit clock or TCP (pin 40). Usually the UART is receiving and transmitting at the same frequency, and thus TCP and RCP can be connected to a common clock source.

One application in which separate receiver and transmitter clocks will be necessary is when the UART is used with the Bell 202-type modem.[2] These modems provide one channel that operates at 1200 bps and a second or reverse channel that operates at 5 bps. The reverse channel is used by the receiver to accept or reject blocks of data sent to it on the high-speed channel. Therefore, the device sending the data would be transmitting at 1200 bps and receiving at 5 bps, while the other end of the link would be receiving at 1200 bps and transmitting at 5 bps.

There are a number of ways —ranging from simple 555 oscillator circuits to complex LSI devices called bit-rate generators, which produce up to 16 commonly (and not so commonly) used bit rates—to generate the 16X bit-rate clock for the UART. The remainder of this article will describe different bit-rate generators and discuss some of the design considerations and trade-offs that I considered when constructing serial interfaces for my computer and hard-copy terminal. However, before talking about the circuits, let's define some communication terms and see if we can determine what type of oscillator can be used as a bit-rate clock.

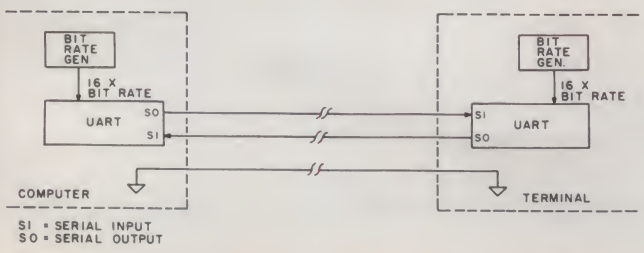


Fig. 1. Simplified serial communications circuit based on UARTs.

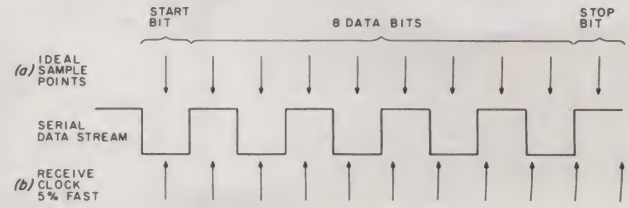


Fig. 2. Serial data stream showing sampling points when (a) receive clock frequency equals transmit clock frequency and (b) receive clock is 5 percent faster than transmit clock.

Bits, Bauds and Characters

In discussions about data communications, you often hear the term "baud" or "baud rate." What does it mean? Is it the same as a bit rate or bps? As near as I can figure the answer to the last question is both yes and no! As to what a baud is, I am sure that if you ask six different people you will get a minimum of six different answers.

The following are three definitions of baud, which, although not strictly correct, should stop you from getting too confused whenever you encounter the term.

(1) A baud is a technical term used in discussions of data communications. Its definition tends to be confusing, especially to the inexperienced, and therefore its use should be avoided whenever possible.

(2) A baud is a term carried over from the days of the telegraph and has to do with the rate at which data is transmitted.

(3) For most *practical* purposes a baud can be considered equal to a bit per second. Baud rate and bit rate can be used interchangeably, but bit rate is the preferred term.

One other word encountered when we talk about data communications is the character rate expressed in characters per second, or cps. The number of characters that can be transmitted in a second depends on the number of bits per character and the bit rate. The Teletype uses 11 bits per character, namely, one start bit, eight data bits and two stop bits. Thus, a bit rate of 110 bps is the same as 10 cps (110 bps divided by 11 bits per character is 10 cps). Higher-speed terminals generally use only one stop bit and thus have 10 bits per character. Therefore 300 bps is equivalent to 30 cps.

Bit-Rate Timing Considerations

Fig. 1 illustrates a simplified serial communication link between a computer and a terminal. In this diagram I have purposely left out the circuits used to change the UART's output and input signals into voltages that correspond to the RS-232 convention. I have also left out the details of how data and control signals are connected to the UART. Interested readers should refer to the referenced articles 1 and 3 for a discussion of these subjects.

Both the computer and the terminal have their own UARTs and clocks. Note that only the UARTs are connected together by their serial data pins. The clocks are not connected together in any way, and thus there is no way to ensure that each clock is set to exactly the same frequency. If the two clock frequencies vary by too great a degree, it will not be possible to pass data between the computer and the terminal.

A good question then is how different can the two clock frequencies be without causing problems. The answer to this question can be obtained by examining Fig. 2. This figure illustrates a 10-bit asynchronous character being transmitted at 300 bps. The start bit is used by the receiving UART to locate the middle of each bit position. This point is called the sample point in Fig. 2 because it is at this point that the UART decides whether the received data is a "1" or a "0."

From Fig. 2, it appears that the receive clock could be up to 5 percent faster (or slower) than the incoming data rate without causing errors. This is because the sample point can, at most, be one-half a bit position in error on the tenth bit received without causing problems.

In the real world, however, the edges of the bit positions do not always occur at the correct point. This is especially true when the data is received from a modem or cassette tape. In this case, jitter causes errors in the true bit position meaning that a 5 percent error in clock rates will result in a large number of received errors. In practice it is a good idea to keep the clock rate accurate to within 1 percent[1] of its theoretical value to ensure trouble-free serial communication. Obviously, the best way to ensure that both bit rates are within a 1 percent tolerance is to use crystal-controlled clocks. However, for noncritical applications in which wide ambient temperature ranges are not encountered and where direct or low-speed modem interconnections are used, a non-crystal-controlled oscillator has been found to be satisfactory.

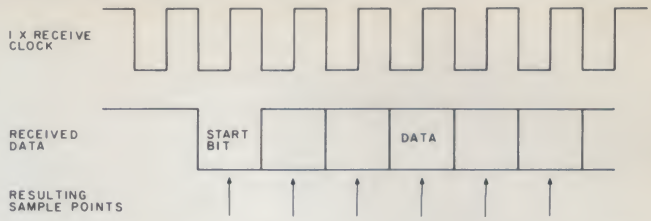


Fig. 3a. Ideal case where received data start bit of received data coincides with rising edge of 1X clock.

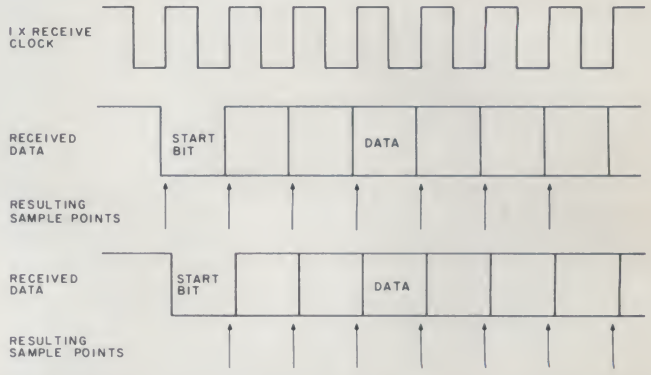


Fig. 3b. Since received data is not synchronous with 1X receive clock, the start bit can occur anywhere between the two extremes illustrated.

AY-5-1013	General Instruments
COM 2502	Standard Microsystems
TMS 6012	Texas Instruments
2536	Signetics
S1883	American Microsystems

Table 1. Pin-compatible UARTs.

One point that hasn't been covered so far is why the UART needs a bit-rate clock whose frequency is 16 times the data rate. Why wouldn't a 1X clock do the job? I glossed over the problem earlier when I said that the UART uses the start bit to locate a sample point for the received data stream at the center of each bit position. How does the UART do this?

Let us assume we have a UART that operates with a 1X clock as shown in Fig. 3a. Then it can be seen that the rising edge of the clock pulse can be used as the sample point. Unfortunately, there is no way to guarantee that the start pulse will occur as shown in Fig. 3a. Since the data sent to the UART is not synchronized to the receive clock, the start bit can occur anywhere between the two extremes illustrated in Fig. 3b.

Obviously, if the sample point is taken as the rising edge of the 1X clock, it can occur anywhere in the start-bit position depending upon the relationship between the start bit and the receive clock. However, if a higher frequency clock is used, the error in locating the center of the start bit will be reduced. It turns out that the error in locating the sample point equals one clock period. To minimize this error all the UARTs listed in Table 1 use a 16X bit-rate clock.

When the serial input line to

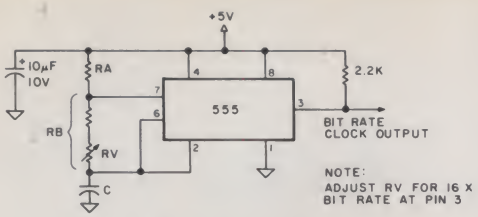


Fig. 4a. 555 bit-rate clock.

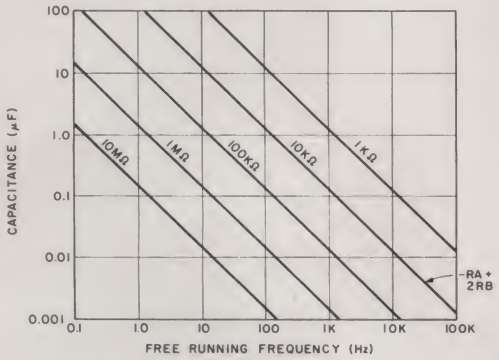
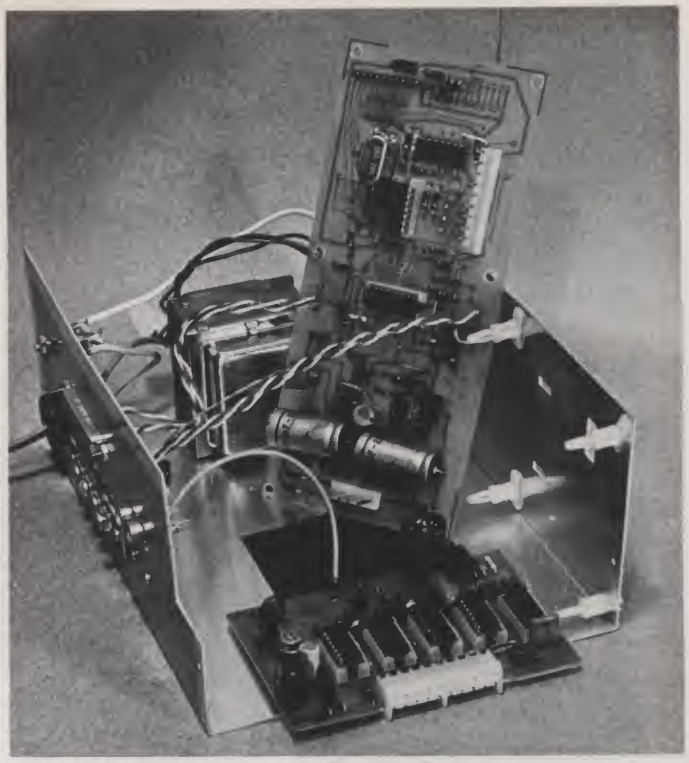


Fig. 4b. Chart for selecting timing components for 555 bit-rate clock (from Signetics Linear Data Book 1972).



CMOS bit-rate generator and Bit Boffer circuit. The bit-rate generator of Fig. 5 is located near the top of the vertical board and consists of the crystal, two CMOS ICs and a few discrete parts. The Bit Boffer circuit, at the bottom of the picture, normally plugs into the connector located immediately below the bit-rate generator on the main circuit board. (Photographs by Bob Padget)

the UART goes low, the UART counts eight clock pulses to locate the center of the start bit. The sample point is then taken as every 16th clock pulse from this point on. Note that for a start bit to be valid it must stay low for the first eight clock pulses. This is done to reject noise on the serial input that otherwise might be taken as a false start bit.

To sum up, the UART is normally waiting for a start pulse; when it detects a valid start pulse, it starts sampling the input lead once every 16 receive clock pulses to determine what characters are being sent to it. When all bits have been received, parallel data is made available to the computer or terminal.

This type of communication is referred to as asynchronous because there is no fixed timing interval between the arrival of different characters. However, within characters the timing is fixed by the 16X bit-rate clock connected to the UART. In asynchronous communications systems each character is "framed" by start and stop bits. This is necessary since if there is no fixed interval between the arrival of characters, the start and stop bits provide the only way to separate and detect characters.

Now that we understand something about clocking requirements for UARTs, let's look at some practical circuits to generate the required clock pulses.

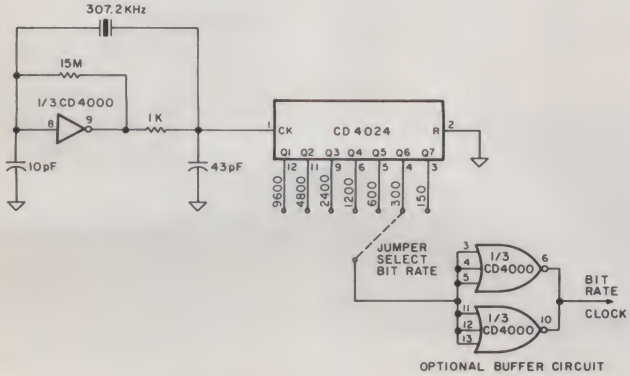


Fig. 5. CMOS bit-rate generator.

555 Bit-Rate Clock

The least expensive and simplest way to build a bit-rate clock is to use a 555 timer wired for astable operation as shown in Fig. 4a. The pot is part of R_B and should be a ten-turn type to allow precise adjustment of the oscillator frequency. Component values can be obtained from Fig. 4b. Remember, the clock must oscillate at a frequency of 16 times the desired bit rate. A frequency counter should be used to fine-tune the circuit.

Note the 10 uF bypass capacitor connected between the 5 volt supply and ground. One of my experimental circuits, built on an S-100 bus breadboard, did not include any bypass capacitors. After many frustrating hours unsuccessfully trying to read data from a cassette interface, I finally discovered that the frequency of the 555 oscillator changed every time the microcomputer was put in the run mode. Adding the bypass capacitor fixed the problem. The moral of this story is to use the bypass capacitor and avoid the grief of trying to figure out what is wrong with your software when the problem lies in the hardware.

The circuit in Fig. 4 works fine, but has the following disadvantages: (a) It must be fine-tuned with a frequency counter. (b) The output frequency can drift with changes in ambient temperature. (c) If a different bit rate is required, it will be necessary to change the circuit's components.

CMOS Oscillator/Divider

Fig. 5 shows a circuit that overcomes all of the disadvantages of the previous circuit. It generates seven common bit rates from 150 to 9600 bps. Note that although the outputs of the 4024 IC are labeled with the bit rate (e.g., 150), the actual output frequencies are 16 times the bit rate (or 2400 Hz for 150

bps). This labeling convention will be used throughout this article.

The circuit in Fig. 5 is quite simple, requiring only two CMOS ICs and a 307.200 kHz crystal. The inverter in the CD4000 package is used in conjunction with the crystal to form a stable oscillator circuit generating 307.2 kHz. The CD4024 is a seven-stage binary counter. The first stage of the counter produces an output of one-half the input frequency, or 153.6 kHz, which is 16 times 9600 bps. Each stage of the 4024 divides its input by two to provide the bit rates shown in Fig. 5.

If required, the remaining two gates in the CD4000 package can be used as shown to buffer the output of the circuit. A switch or jumper can be used to select the desired bit rate. Alternately, the circuit can be used as is to drive a number of UARTs at different bit rates. This would be useful, for example, where an interface board connected to a high-speed CRT at 9600 bps and a low-speed terminal at 300 bps. If a third UART were available, it could be used to drive a medium-speed printer at 1200 bps.

The circuit of Fig. 5 has two disadvantages: (a) Finding a source for a reasonably priced 307.200 kHz crystal is difficult. (b) The circuit does not provide a 1760 Hz output required for 110 bps normally used with Teletypes.

TTL MSI Baud-Rate Generator

The circuit shown in Fig. 6[4] is particularly attractive for S-100 bus interfaces, since it uses the 2 MHz clock signal on pin 49 of the bus rather than a crystal. Accuracy of this bit-rate generator's output depends on the accuracy of the 2 MHz clock. The circuit can be programmed to generate any output frequency from 500 Hz to 2 MHz.

The circuit is a counter loaded with the two's complement of the divisor required to divide the 2 MHz signal down to the desired bit rate. When the carry output of the last counter goes high, it generates an output clock pulse and a load signal to reload the divisor back into the counter.

The divisor is set in the switches S_1 to S_{12}, which should be a set of DIP rocker switches. For example, for a bit rate of 110 bps, an output frequency of 1760 Hz is required. To divide 2 MHz down to 1760 Hz, a divisor 2,000,000/1760 = 1136 is required. 1136 in binary is 010 001 110 000. To find the two's complement of this number invert each bit and add 1. 010 001 110 000 inverted becomes 101 110 001 111, then add 1.

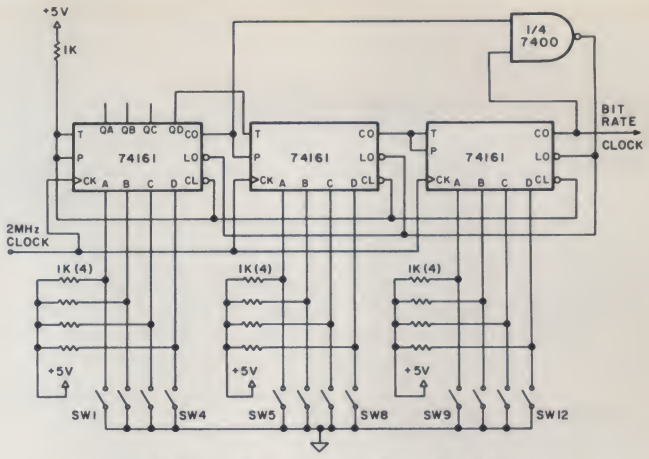
```
  101 110 001 111
+             001
-----------------
  101 110 010 000
```

Here the least significant bit corresponds to SW1 and the most significant to SW12. Each "1" is an open or off switch, while the zeros are closed or on switches. Fig. 6 also shows the switch settings for some common bit rates. Note that by use of two 74174 hex latches loaded from an output port to replace the rocker switches, the bit rate could be selected under software control.

The circuit in Fig. 6 also has some disadvantages: (a) Only one frequency can be generated at a time. (b) Setting up the desired frequency is complicated.

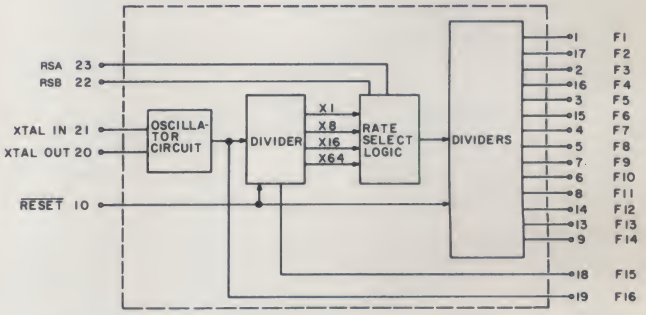
The MC14411P Bit-Rate Generator

The Motorola MC14411P is a CMOS LSI circuit that contains a crystal oscillator, rate-select logic and the dividers required to generate 14 different bit rates from 75 to 9600 bps. An



BIT RATE	16 X BIT RATE	DIVISOR	SWITCH SETTINGS 12 11 10 9 8 7 6 5 4 3 2 1
110	1760 Hz	1136	1 0 1 1 1 0 0 1 0 0 0 0
300	4800 Hz	417	1 1 1 0 0 1 0 1 1 1 1 1
1200	19200 Hz	104	1 1 1 1 1 1 0 0 1 1 0 0 0

Fig. 6. TTL bit-rate generator for S-100 bus systems.



OUTPUT PIN	OUTPUT RATES (Hz) X64	X16	X8	X1
F1	614.4K	153.6K	76.8K	9600
F2	460.8K	115.2K	57.6K	7200
F3	307.2K	76.8K	38.4K	4800
F4	230.4K	57.6K	28.8K	3600
F5	153.6K	38.4K	19.2K	2400
F6	115.2K	28.8K	14.4K	1800
F7	76.8K	19.2K	9600	1200
F8	38.4K	9600	4800	600
F9	19.2K	4800	2400	300
F10	12.8K	3200	1600	200
F11	9600	2400	1200	150
F12	8613.2	2153.3	1076.6	134.5
F13	7035.5	1758.8	879.4	109.9
F14	4800	1200	600	75
F15	921.6K	921.6K	921.6K	921.6K
F16	1.843M	1.843M	1.843M	1.843M

B	A	RATE
0	0	X1
0	1	X8
1	0	X16
1	1	X64

Fig. 7. MC14411P bit-rate generator.

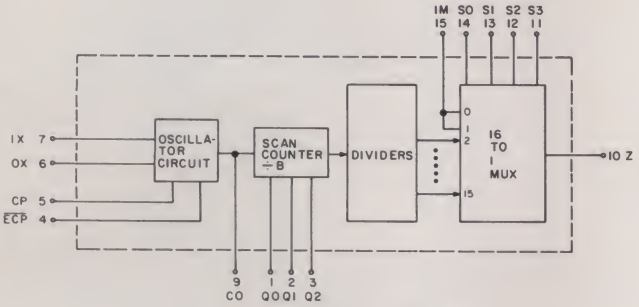
Bit Rate Generator	Cost	Xtal Freq	Xtal Cost	Available From	Special Features
555 Timer	$ 2.50	NA	-	Any Place	Only generates one freq.
TTL MSI	$ 8.00*	2 MHz	-	Any Place	Use 2 MHz S-100 bus clock
CMOS	$ 1.00	307.2 kHz	Expensive		7 Outputs 150 to 9600 bps
MC14411P	$12.00	1.8432 kHz	5.00	Tri-Tek	16 Simultaneous outputs from 75 to 9600 bps plus 1.8632 MHz and 0.9216 MHz, Programmable for X1, X8, X16, X64 clocks
34702	$14.00	2.4756 MHz	6.00	Advanced Computer Products	14 Selectable Rates from 75 to 9600 bps X16 Clock rate

*Includes $4.00 for DIP switches.

Table 2. Bit-rate generators.

external 1.8432 MHz crystal is required for proper operation. The MC14411P is set up to provide clock frequencies equal to the bit rate, eight times the bit rate, 16 times the bit rate or 64 times the bit rate. Two rate-select inputs allow the selection of one of the four bit-rate multipliers. In most cases, pin 22 will be held high and pin 23 low to enable the generation of clocks that are 16 times the bit rate.

The MC14411P is shown schematically in Fig. 7; note that all 14 bit-rate clocks are available from different pins on the IC. Each output can drive one low-power TTL load. In addition, buffered outputs at the crystal frequency and one-half the crystal frequency are also available. Note that the output rates shown in Fig. 7 are the clock frequencies and must be divided by the rate (X1, X8, X16 or X64) to make a determination of the actual bit rate.



S3	S2	S1	S0	(Z) BIT RATE *
0	0	0	0	1M
0	0	0	1	1M
0	0	1	0	50
0	0	1	1	75
0	1	0	0	134.5
0	1	0	1	200
0	1	1	0	600
0	1	1	1	2400
1	0	0	0	9600
1	0	0	1	4800
1	0	1	0	1800
1	0	1	1	1200
1	1	0	0	2400
1	1	0	1	300
1	1	1	0	150
1	1	1	1	110

*ACTUAL OUTPUT FREQUENCY IS 16 TIMES BIT RATE

Fig. 8a. 34702 bit-rate generator.

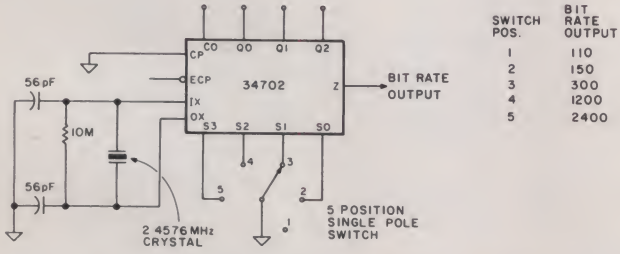


Fig. 8b. Simple bit-rate generator based on the 34702.

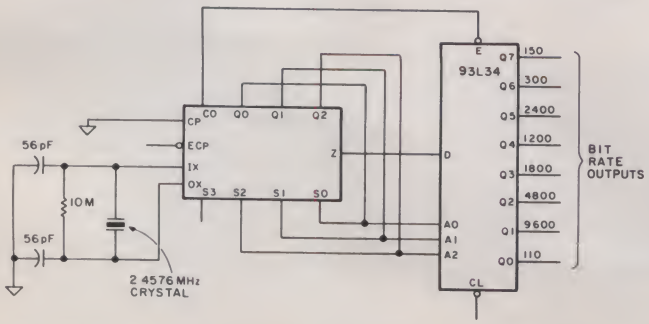


Fig. 8c. 34702 bit-rate generator with eight simultaneous outputs.

34702 Bit-Rate Generator

The 34702, made by Fairchild[5], is the most versatile (and most expensive) of the bit-rate generators discussed in this article. Like the Motorola MC14411P, it is a CMOS LSI circuit incorporating an on-chip crystal oscillator and bit-rate counter circuits. Unlike the MC14411P, the 34702 also contains a multiplexer and a scan counter. The 34702 generates a clock that is 16 times the bit rate when an external 2.4576 MHz crystal is attached to the circuit. Four inputs control the multiplexer to select one of 13 bit rates from 50 to 9600 bps.

Besides the bit-rate output, the 34702 has four other outputs, one at the clock frequency and three at one-half, one-quarter and one-eighth the clock frequency, respectively. These last three are called the scan-counter outputs and are used in applications in which the output of the 34702 is to be demultiplexed to provide a number of different bit rates.

The chip also has provision to use an external clock signal rather than a crystal. This signal is applied to the CP pin. The pin labeled $\overline{Ecp}$ selects this external clock when it is taken low. When $\overline{Ecp}$ is high, a crystal must be connected between Ix and Ox as shown in Fig. 8b. All 34702 outputs are capable of driving a standard TTL load.

The 34702 is shown schematically in Fig. 8a. Fig. 8b shows a simple circuit using the 34702 to provide one of the five common bit rates. A five-pole, single-throw switch is used to select 110 bps, 150 bps, 300 bps, 1200 bps or 2400 bps. Obviously someone was thinking when he set up the multiplexer coding to work in this manner.

Fig. 8c shows that an external addressable latch, the Fairchild 93L34, can be added to the 34702 to allow eight simultaneous bit rates to be generated. This circuit uses the 34702's scan-counter outputs to control its own multiplexer, as well as the address in the latch where the bit-rate data is being written.

Table 2 provides a summary of the bit-rate generators described above and includes price and availability information. It should be of assistance to anyone who is designing a clock circuit for a UART or other serial communications device.

Applications

In the past year I have built three different circuits that required a bit-rate clock in their design. In each case, I chose to use a different bit-rate generator circuit. The remainder of this article will describe these circuits and discuss the trade-offs made in selecting which bit-rate clock to use for each application.

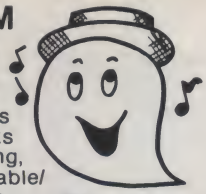
Hard-Copy Terminal

In one recent project[6], a UART was designed into a hard-copy terminal to provide it with a serial communications capability. Due to its mechanical design, the terminal is limited to typing at a rate of 13.5 characters per second (i.e., 135 bps). Therefore, there is no reason to have a bit-rate clock that provides a choice of a number of different bit rates. The only flexibility that might be required is to allow it to communicate at a slower rate, such as 110 bps.

Since the 555 IC bit-rate generator is the simplest and most inexpensive circuit, it seemed most suitable for this undemanding application. However, it is hard to change the frequency of this circuit; therefore, I decided to set it up for 110 bps, which is more commonly used than 135 bps. The resulting circuit is shown in Fig. 9. Note that the circuit can probably be tuned to 135 bps (2160 Hz), but a frequency counter is required to ensure that it is set at the correct rate. In my application, I always use the terminal at 110 bps and have found the bit-rate clock to work very well after initial tuning to 1760 Hz.

The second application involved the Bit Boffer[7] cassette recorder system designed by Don Lancaster. This circuit re-

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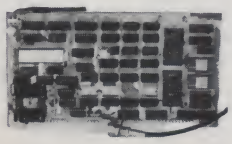
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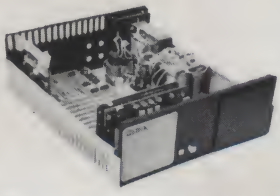


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0	0	0	1	110
0	0	1	0	134.5
0	0	1	1	300
0	1	0	0	*
0	1	0	1	2400
0	1	1	0	4800
0	1	1	1	1/16 of EXT CLK
1	0	0	0	600
1	0	0	1	440
1	0	1	0	Non Standard
1	0	1	1	1200
1	1	0	0	*
1	1	0	1	9600
1	1	1	0	19.200
1	1	1	1	1/16 of EXT CLK

Jumper at	*Bit Rate SW3 = 0	SW3 = 1	
F2	7 200	28 800	*Depends on jumper position
F4	3 600	14 400	
F6	1 800	7 200	
F10	200	800	e.g., Jumper at F6
F14	75	300	

then 0100 1800 bps
1100 7200 bps

Table 3. Bit-rate outputs for circuit shown in Fig. 10.

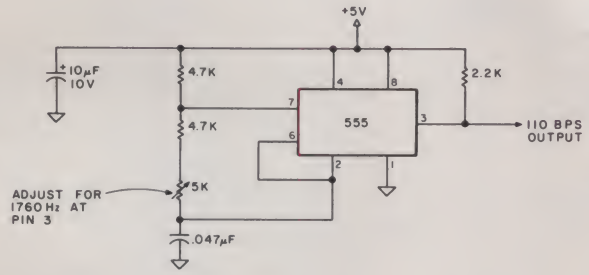


Fig. 9. 555 bit-rate clock for hard-copy terminal.

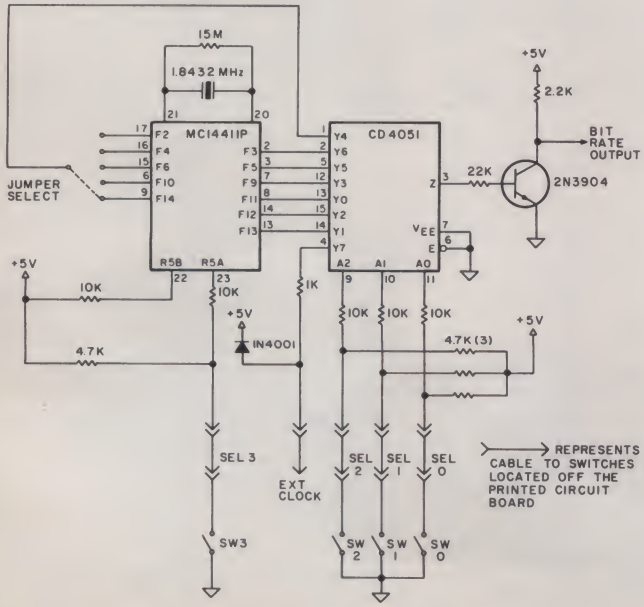


Fig. 10. Bit-rate generator based on the MC14411P.

quires a clock which is 64 times the desired bit rate. While I suppose I could have used the 555-type clock, I chose to use the CMOS bit-rate generator shown in Fig. 5 for the following reasons.

1. I wanted some flexibility to try higher bit rates than 300 bps normally used with this cassette recording standard.

2. I felt that the stability of a crystal-controlled clock was important to the proper performance of the cassette recording technique.

3. I had bought some 307.2 kHz surplus crystals for 25¢ each.

A source of reasonably priced crystals is what really makes the circuit in Fig. 5 practical. Unfortunately, crystals in the required frequency range tend to be expensive. If anyone has a source for low-cost 307.200 kHz crystals, please write and let other *Microcomputing* readers know where they can be obtained.

One other alternative is to use the crystals for the MC14411P or 34702 divider chip to produce a 307.2 kHz signal. 2.4576 MHz divided by 8 is 307.2 kHz, while 1.8432 MHz divided by 6 is 307.2 kHz. Still another possibility is to use a CD4040 12-stage binary counter and a 2.4576 MHz crystal in a circuit similar to that of Fig. 5. It may be necessary to try a number of different capacitor values to get a 2.4576 MHz crystal to work in the circuit shown in Fig. 5. The first three stages of the CD4040 will divide the 2.4576 MHz signal down to 307.2 kHz, leaving nine stages to produce the outputs shown in Fig. 5 (note that only seven stages are needed).

Another recent project involved the design of a serial interface for my BIT 483 computer. This interface is based on an AY5-1013 UART, and I wanted to include a reasonably flexible bit-rate generator on the card. The design goals for the bit-rate generator portion of the circuit include:

(1) A variety of bit rates had to be available so that terminals operating at 110 bps or 300 bps, and CRTs operating at 2400 bps or 9600 bps could be easily accommodated.

(2) It should be very easy to switch between bit rates.

(3) The circuit should be small since not much board space is available.

Clearly, only the MC14411P or the 34702 fits all the design requirements. The 34702 would appear to be the best choice because it includes a multiplexer that is required to satisfy design goal number 2. The 34702 with crystal currently costs about $22, while the 14411P and crystal is about $17.

However, at the time I was designing the circuit no "hobby" type suppliers offered the 34702 for sale. The only chip readily available was the 14411P from Tri-Tek. Tri-Tek has always provided me with good service and quality parts. Therefore, based on price and availability, I decided to use the MC14411P. A low-cost CMOS multiplexer was added to the bit-rate generator to allow a set of DIP switches to choose one of the 14 bit rates from 14411P as the bit-rate clock.

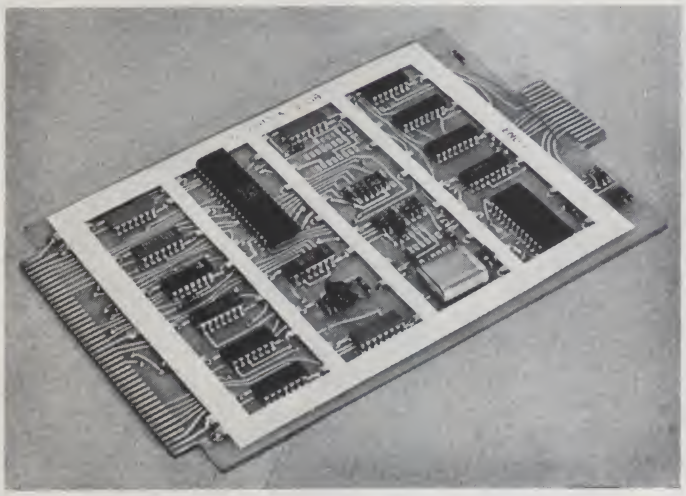
The resulting circuit is shown in Fig. 10, while Table 3 lists the bit-rate frequencies available from the circuit. Besides the MC14411P and its crystal, the circuit includes a CD4051 digital multiplexer and a 2N3904 transistor to buffer the output of the 4051. While this transistor might not be strictly necessary, I felt it was a good idea to include it, especially if more than one UART was to be driven by the circuit.

The four DIP switches used to select the bit rate and the external clock input are not located on the same board as the bit-rate generator. Therefore, resistors were inserted in series with each input lead to protect the CMOS circuits when power was applied to one board but not to the bit-rate board.

Under these conditions the CMOS circuits could be damaged if these resistors were not present. The external clock input, pin 4 of the CD4051, is a useful feature because it allows circuits that

generate their own clock signals, such as the Bit Boffer[7], to be used with the UART on this interface board.

Table 3 shows that there are 16 different bit rates available from the circuit shown in Fig. 10. Some of you are probably wondering how an 8-input multiplexer can be used to select an output from 16 inputs. The trick is to use SW3 to switch the MC14411P from its X16 to its X64 mode. In the X64 mode the frequency generated at any pin of the MC14411P is four times the frequency generated at that pin in the X16 mode. For example, the F_{11} output, which generates a 150 bps clock (2400 Hz) in the X16 mode, will generate a 600 bps (9600 Hz) in the X64 mode. Since the external clock input does not come from the MC14411P, it is not affected by SW3 being opened or closed.



MC14411P bit-rate generator mounted on serial interface board. The circuit shown in Fig. 10 is located near the crystal on this board. The 24-pin IC is the MC14411P; immediately next to it is the CD4051 multiplexer. Other circuits on the board include a UART (the largest IC), a parallel input port and bus drivers for my surplus minicomputer (a BIT 483).

Conclusions

You may be tempted to forget about the bit-rate clock because it is an auxiliary function to the UART; however, proper operation of a serial communication circuit is highly dependent on the reliable operation of the clock circuit. Selecting a UART is a simple matter of obtaining one of the many pin-compatible devices listed in Table 1. On the other hand, as we have seen, there are many different ways to build the UART clock.

This article, and particularly Table 2, should help you select and design the bit-rate clock that will be best suited to your next UART application. Although Table 2 does not list all the bit-rate generators currently being produced, it does include those of greatest interest and availability to the computer hobbyist. ■

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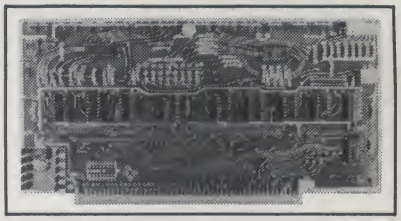
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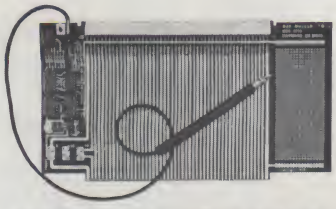
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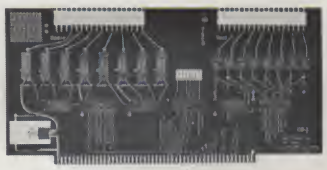
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Exploring the Inequality of Bus Buffers

All buffer chips are not created equal. If you don't know your 74366s from your 8T95s, for example, here's your chance to read and learn more about buffers.

John R. Cameron
PO Box 1517
Palo Alto CA 94301

This article has the solution for a bus buffer problem you may not have recognized . . . yet. But first, let me describe the situation.

One of the common characteristics of a flexible microcomputer system is the use of a bus, a collection of many, more-or-less parallel conductors with sockets that connect the CPU card (central processing unit board) to one or more auxiliary cards. The ability to change the number or type of auxiliary cards by merely plugging them into sockets on the bus provides the adaptability many of us need in our home or business computers. It also produces often difficult problems of compatibility.

How It Works

In practice, the use of a bus requires that most input or output lines from the CPU be connected to several different auxiliary cards' outputs or inputs at once. However, the CPU chips in use today cannot provide a sufficient output current to reliably service much more than one LSTTL (low-power, high-speed Schottky) load.

Furthermore, the various auxiliary boards' outputs would try simultaneously to send different signals to the CPU's inputs. On some bus systems (i.e., 16-bit S-100), the CPU's input and output must be multiplexed together on a single set of eight or 16 lines so that either input or output, not both, is occurring at one time.

These traffic flow considerations are all solved by the use of several different types of bus buffer devices that amplify the current flow capability of a signal put on the bus and, in some cases, turn signals off when they are not desired.

General characteristics of the integrated circuits used as

Device Number	Buf. #	Inv. ?	Out. I H	Out. I L	Inp. I H	Inp. I L	P.S. I /Buf.	¢ /Buf.	Comp. Group	Notes
7404	6	Y	0.4	16	.04	1.6	5.5	3	1	2-state
74LS04	6	Y	0.4	8	.02	0.4	1.1	4	1	2-state
7406, 07, 16, 17	6	Y/N	<25	40	.04	1.6	7.0	4	1	open collection
74125, 126	4	N	5.2	24	.04	1.6	15.5	10	2	
74LS125, 126	4	N	2.6	16	.02	0.4	5.3	13	2	
74LS240	8	Y	15	24	.02	0.2	4.1	25	3*	Schmitt trigger
74LS241, 244	8	N	15	24	.02	0.2	5.4	25	3*	Schmitt trigger
74365, 367	6	N	5.2	32	.04	1.6	14.2	10	4	
74LS365, 367	6	N	2.6	24	.02	0.4	4.7	11	4*	
74366, 368	6	Y	5.2	32	.04	1.6	12.8	10	4	
74LS366, 368	6	Y	2.6	24	.02	0.4	4.3	11	4*	
8093, 94	4	N	5.2	16	.04	1.6	15.5	10	2	
8095, 97	6	N	5.2	32	.04	1.6	14.2	11	4	
8096, 98	6	Y	5.2	32	.04	1.6	12.8	11	4	
81LS95, 97	8	N	2.6	16	.02	0.4	3.3	10	5	economical
81LS96, 98	8	Y	2.6	16	.02	0.4	2.6	10	5	economical
8T95, 97	6	N	5.2	48	.04	0.4	16.7	22	4*	premium
8T96, 98	6	Y	5.2	48	.04	0.4	15.8	22	4*	premium
S-100 standard	-	-	>2	>24	<.08	<0.8	-	-	*	

Table. 1. Parameters of various bus buffers. Data for this table was collected from Signetics (1978) and National Semiconductor (1976) TTL data manuals.

bus buffers and their application have been described in Kilobaud Klassrooms by George Young (May 1978, p. 54) and Peter A. Stark (Aug. 1978, p. 36). Briefly, they are TTL chips connected between the CPU chip or auxiliary board circuits and the bus lines.

The chip contains several independent buffers, each with input and output pins. The signal on the output pin is either the logical equivalent (1 or 0) of the signal on the input pin or its logical inverse, depending on the chip used.

Most have the additional capability of turning their outputs to a third state, off or high impedance, where they do not influence the bus line. Another buffer can then send its data on that line. This is controlled by the signal on one or two other pins on the chip referred to as chip enable or disable pins.

The proposed S-100 bus standard of the IEEE Computer Society Microprocessor Standards Committee calls for most status and control signals (14) as well as all address (16) and data lines (16) to be buffered with such three-state devices on the CPU card to allow multiple auxiliary cards, any one of which can control the bus by shutting off normal CPU control commands (direct memory access).

The Problem

A problem arises when the buffers on the CPU card or on the auxiliary cards (if these even have buffers) are incapable of providing sufficient current to reliably maintain a particular bus line *and* all the inputs connected to it at the desired logic voltage level. Typically, an address line buffer required to output a logic 1 (2.0 to 5.0 volts) will not source enough current to supply the many address inputs on auxiliary cards (quite possibly over 50 due to the lack of input buffers on many auxiliary boards), and the voltage then drops below 2 volts.

Note that at the high rates of signal change occurring in fast microprocessors, long bus lines have an electrical characteristic such that they require "filling up" with current. Such a characteristic, combined with insufficient current output, produces an uncertain logic level (0.8 to 2.0 volts) along the bus's address line. Quite simply, your program may occasionally go flying off to parts unknown with no obvious provocation.

The Solution

Do not despair: The solution to this problem or its prevention through prophylactic analysis of your system is direct and easy to understand. You simply determine the output current capabilities and input current requirements at both low and high logic levels for each significant bus line in your system.

If each line is buffered on both input and output ends with typical devices, then all the information you need is in this article. If some of your system's bus inputs are not buffered, you will have to look up the necessary information on input current requirements for each chip on that line and add them up for both logic levels.

Relevant data on typical bus buffer chips for this analysis is provided in Table 1. All of these devices are three-state except for those in the first three lines, which are ordinary two-state or open collector as noted.

Open collector devices require a pull-up resistor to the positive logic level in order to source any significant output current (logic-high output), and the value of this resistor determines, up to a point, the maximum value of this current. Most TTL or LSTTL devices will require the same amount of input current as do the 7404 and 74LS04 devices, respectively.

The unsigned output and input currents (I) in Table 1 are in milliamperes (mA) and are specified for a high logic level of 2.4 volts and a low logic level of 0.4 volt. This provides a safety margin of 0.4 volt at both logic levels. Power supply current is in mA for the worst-case no-load situation.

Cost per buffer is based on single unit discount prices. Buffer specifications in the proposed standard for the S-100 bus (published in *Dr. Dobb's Journal*, number 25, p. 40, by George Morrow and Howard Fullmer) are given on the bottom line, and those bus buffer chips that fulfill these specifications are indicated by an asterisk in column 10.

Schmitt-triggered devices have reduced noise sensitivity, and these devices may be especially useful for input conditioning. Transceivers (used on bidirectional lines) have not been included, and low-power versions of 80- (80L-) and 81LS- (71LS-) are not usable for microcomputer buses due to insufficient output currents.

A convenient characteristic of certain bus buffer chips is compatibility. All of the three-state chips with six buffers listed are pin-for-pin compatible (Comp. Group 4 in column 10), if attention is paid to the sense of the data (Inv. ? in column 3) and the implementation of the enable/disable pins within a particular group.

Three-state devices on the same line in Table 1 differ only in the latter characteristic, and the use of 5 or 7 and 6 or 8 as the last numeral in their device number clarifies the compatibility in this respect. Such compatibility allows you to simply exchange devices in a socket if more output current capability or less input current loading is required for that chip.

Unfortunately, six buffers per chip do not service 8- or 16-bit parallel lines very conveniently. The worst compatibility problem where no buffers exist might require alteration of the circuit to include them or the purchase of a different board, if there is a choice.

Thus, the presence of both input and output three-state buffers on a board increases its flexibility. It also increases its power consumption and cost. These two considerations are treated on a per buffer basis in columns 8 and 9 of Table 1.

	Fanout Number				
	High	Low		Low	
Device	0.04 mA	0.4 mA		1.6 mA	
Number	Unte.	Unte.	Term	Unte.	Term.
7404	10	40	7	10	2
74367	130	80	47	20	12
74LS367	65	60	27	15	7
81LS97	65	40	7	10	2
8T97	130	120	87	30	22

Table 2. Some typical fanout numbers.

Some Fine Points

Table 2 describes some common bus load capabilities (expressed in fanout numbers) for the more frequently used bus buffer chips. It also points out the effect of having a resistor network termination on each bus line.

The maximum number of inputs serviced by some common buffers is given according to the input currents at high or low logic levels, with or without a resistive termination network. The typical network chosen consists of a 330 Ohm resistor to +5 volts and a 470 Ohm resistor to ground.

The signed output current of such a network for a particular bus line voltage is the sum of the signed currents for each resistor determined using the voltage drop across each — signed current = (line voltage minus 5 or 0) divided by the resistance. Note that these fanout numbers only apply if the input devices used require less than 0.8 volt for low and greater than 2.0 volts for high logic levels. Some non-TTL-compatible devices have more stringent requirements.

The network chosen tends to keep the line at 3 volts, which benefits a high logic output (pull-up) but loads a low logic output at 0.4 volt to the extent of 13 mA (33 LS input equiva-

lents). Such a passive termination network helps reduce noise and ringing on the bus, which can give erroneous signals at higher clock speeds; unfortunately, this comes at the price of drastically increasing the load on a buffer's output signals to a bus line and, as Table 2 shows, the number of inputs allowed on that line.

The wisdom of using input buffers that require less input current at a low logic level (0.4 mA) is also demonstrated. Note that when most Tri-state buffers are disabled, their inputs source far less current (provide about one tenth their normal enabled load to a low logic level signal).

Addition of a buffer to a signal line adds a small amount of delay to the signal's propagation, which could be a significant consideration in a high-speed system. The maximum propagation time for the three-state devices listed (from a disabled state to output high or low) is from 15 to 37 nanoseconds. This variation among different device types is not much more than that seen with individual devices of the same type. However, premium devices can save several nanoseconds in propagation time when the device is continuously enabled.

The 8T- series of devices has the reputation of being a premium series in terms of power, speed and noise insensitivity. These devices also cost twice as much as, and use more power than, other devices with almost identical published parameters.

Certain difficult-to-specify qualities of this series may make it better for critical applications. In one experience, a noisy 2708 EPROM (16K) board gave incorrect output data about one time in 10^4 with several 74LS367 or 74367 output buffer chips but worked perfectly with several different 8T97 chips.

Apparently, the 8T97 was able to better differentiate proper logic levels from noise-induced glitches finally found to be due to a bad capacitor on a voltage regulator output. Replacement of the capacitor was a more satisfactory solution in this case, but the 8T97s are still there to increase the margin of error.

I wrote this article after compiling information on bus buffer chips, which is useful to me in designing or modifying boards for my computer. I hope it will also help others in this way or, at least, expand understanding of these not very elaborate but still important devices. ■

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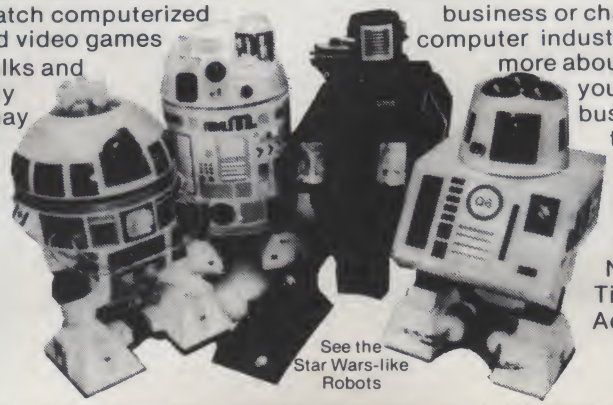
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Elfish Ideas

Elves, by nature, are quick. Here are some ways to hasten your Elf's I/O.

Are you tired of seeing serial I/O interfaces for your Elf that use only the Q register for output and an EF line for input?

I don't like the idea of tying up valuable CPU time doing timing loops for a Teletype. To me, it is far easier to output or input a byte using an I/O port and have the device set a flag line to tell me when it is done. In this article, I hope to show you a few ways to speed up your Elf's I/O without spending too much money.

The circuit in Fig. 1 is a simple UART (universal asynchronous receiver/transmitter) interface. This circuit can be used to interface almost any serial I/O device to the Elf. I am presently running this UART circuit on my Elf with a Datapoint display running at 2400 baud with 1K of memory. You can even use this circuit as a cassette interface by adding a modem to the serial input and output lines of the UART.

The UART is a TR-1602 from Western Electric. Any similar UART will work, however. The TR-1602 requires +5 and −12 volts for operation. The transmit and receive clocks must be 16 times the desired data rate; so to run at 300 baud, for instance, you would need a transmit and receive clock frequency of 4800 Hz. For a stable clock, you could derive the clocks from a crystal oscillator; but in order to save money, an NE 555 oscillator, shown in Fig. 2, will work fine.

The UART in Fig. 1 is configured for a 7-bit word with odd parity and one stop bit. The UART, however, may be set up for any word length from five to eight bits, with odd, even or no parity and with one or two stop bits. My display is a 7-bit, odd parity, ASCII device, so I will confine my circuit descriptions to this configuration.

The Transmitter

Data from the CPU is strobed into the UART with a 62 instruction. This instruction places the byte addressed by the X register onto the data bus and sets the N lines to 2. The N lines are decoded by the 74154 into 16 discrete lines. The Elf can access up to seven output and seven input devices directly from the N lines.

Pin 3 of the 74154 will go low when the N lines are equal to a 2 and an output instruction is being performed. This will cause the byte on the data bus to be loaded into the UART's transmitter buffer.

The UART has a two-character buffer, so a second character may be loaded into the UART while the first character is still being sent. Pin 22 of the UART provides $\overline{TX\ BUSY}$, which may be used to indicate to the CPU that the transmitter buffer is full and that any further loading of data into the UART will write over the data in the buffer.

Positive true serial TTL data comes out of pin 25 of the UART. This can be used to provide RS-232 data. I am using the Motorola 1488 and 1489 RS-232 interface chips, but any of the interfaces described by Dr. Mark Boyd in "Interfacing Tips" (*Kilobaud*, February 1978, p. 72) should perform as well.

The Receiver

Positive true serial TTL data is fed to the UART at pin 20. Upon receipt of a character, the

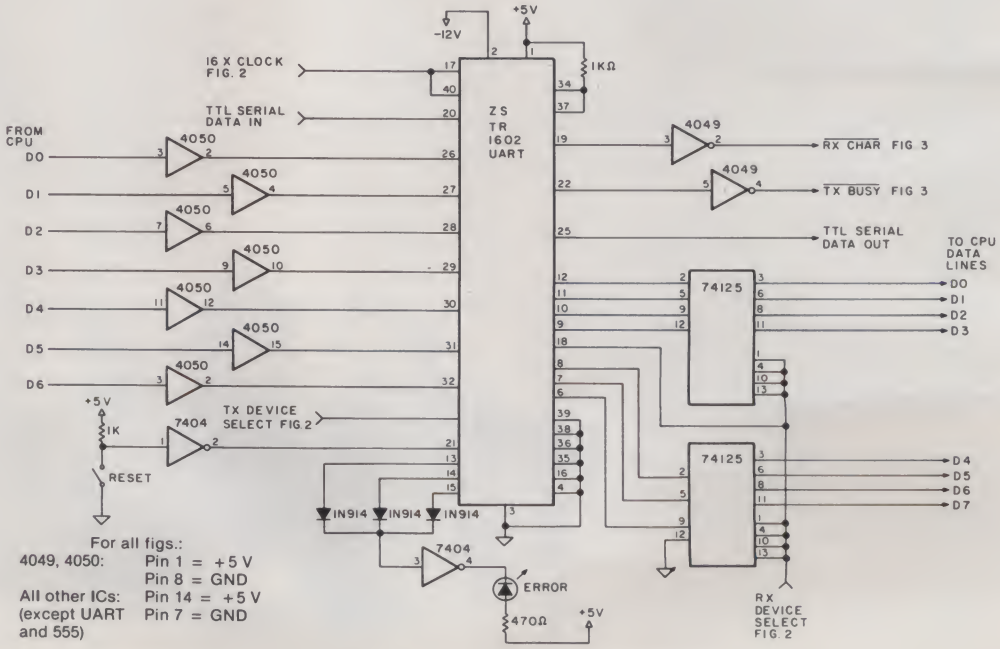


Fig. 1. UART interface circuit.

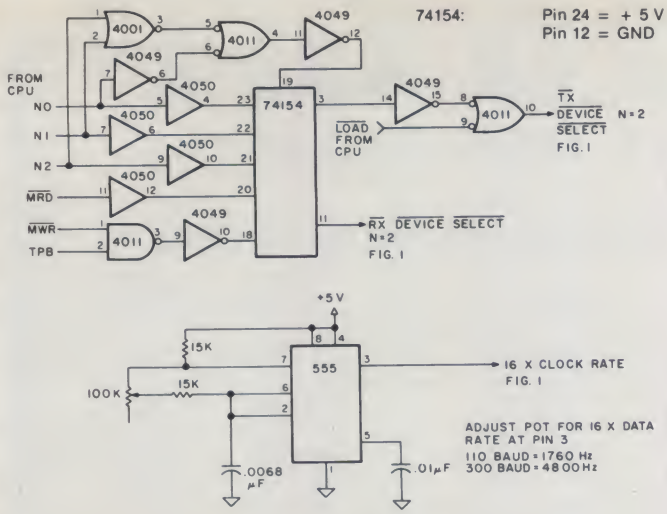


Fig. 2. NE 555 oscillator.

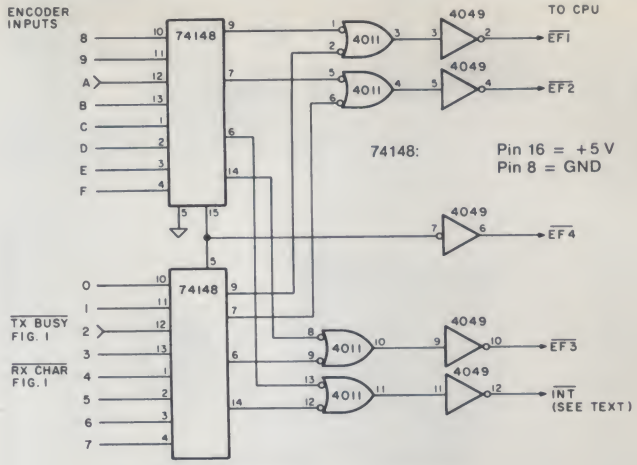


Fig. 3. Priority encoder circuit.

error conditions, if any, are indicated, and pin 19 of the UART provides RX CHAR, indicating to the CPU that a character has been received. The UART receiver data is gated onto the data bus with a 6A instruction (N lines = 2) and written into the memory location specified by the X register.

The EF Line Encoder

The circuit shown in Fig. 3 is a 16-line to 4-line priority encoder. This takes the input flag line with the highest priority and provides the binary code for that line on the output of the encoder. Line F has the highest priority, and line 0 has the lowest priority.

In addition, a fifth line, which I call INT, goes low whenever a request for the CPU is made via the input flag line of the encoder. This may be used to provide an interrupt to the CPU. Care must be taken if the CPU is not programmed to handle interrupts because the CPU may tend to walk all over your program in core. If you are not going to run under interrupt control, I suggest that you leave the INT line from the encoder disconnected.

Summary

A short program to test the serial interface is shown in Fig. 4. It will fill the screen with "HI" until you hit a key. The serial interface and priority encoder, when used together, increase the Elf's I/O flexibility. No longer will the CPU be twiddling its thumbs in a timing loop waiting for a Teletype.

I am presently writing a small system monitor for my Elf, using my present system and a cassette interface as well. Anyone interested in a program listing of the monitor, when completed, should write me for more information. ■

ADDR.	INSTR.		
0000	35	b2	loop if TTY is busy
0001	00	00	loop address
0002	62	out	output immediate byte
0003	48		ASCII 'H'
0004	35	b2	loop if TTY is busy
0005	04		loop address
0006	62	out	output immediate byte
0007	49		ASCII 'I'
0008	35	b2	loop if TTY is busy
0009	08		loop address
000A	62	out	output immediate byte
000B	20		ASCII 'space'
000C	3E	bn3	branch if key has not been hit
000D	00		branch address
000E	00	idl	idle CPU if key has been hit

Fig. 4. Program to test serial interface.

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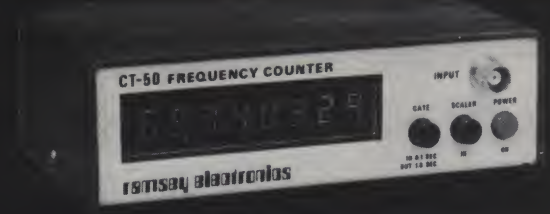
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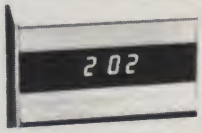
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✔ R8

✔ Reader Service—see page 227

Load Programs the SIMPL Way

The author of this article has taken a cue from the maxi-computer boys and written a loader for his system. It's an idea that can be utilized to work on your micro, too.

Harold B. Combs
809 Englewood
Del City OK 73115

Computers should be simple, I thought to myself as I spent several months loading BASIC from one tape, my Assembler from another tape and my utility program from yet another. I went through this time-consuming ritual every time I sat down to program, until I finally got fed up. I decided there must be a better way. Therefore, I borrowed an idea from the big computers and wrote myself an IPL program.

IPL stands for Initial Program Load. In the big machines it is a bootstrap program to load the monitor into memory. But my program does much more.

Now, when I want to program, I just put the IPL tape into my recorder, press play and type XEQ. I can then ignore the computer for a few minutes knowing that when I return, it will be ready to run BASIC or Assembler at my option.

The Program

The program SIMPL is written in 8080 assembly language and is currently running on my Sol-20 system with the Solos monitor. SIMPL stands for Solos Initial Multiple Program Load. It loads into memory all programs that follow it on the IPL tape, until it finds a program named END. It will then link BASIC, Assembler and the utility program to my system monitor. Therefore, all I have to do to run either one is enter a two-letter command. Finally, it will ask the operator for the current date and store this information in a safe place for other programs to have access to.

The IPL Tape

The IPL tape is an important part of SIMPL. The first file on the tape is, of course, SIMPL; after that you may have as many files as you like (or have memory for).

Remember that the last file on the IPL tape must be named END. This can be a dummy file or an actual program, since the file is loaded before a check is made on the name. One rule that must be observed in creating the IPL tape is to leave at least three seconds of blank space between tape files to allow time for the tape to stop and get up to speed again. If this is not done, you are likely to experience recurring read errors.

My IPL tape contains SIMPL, BASIC, Assembler, my dump program and a dummy file named END, in that order. You may want to put BASIC, followed by one of your favorite games, on your IPL tape; therefore, when SIMPL is finished, not only will you have BASIC in memory, but the game will also be ready to run (see Example 1).

```
SIMPL D 4C00 032F
          S.I.M.P.L.
Solos Initial Multiple Program Load

IPL1010   IPL  NOW  IN  PROGRESS
IPL1020   SUCCESSFUL PROGRAM LOAD
IPL1030   FILE NAME :  BASIC
IPL1020   SUCCESSFUL PROGRAM LOAD
IPL1030   FILE NAME :  ALS-8
IPL1020   SUCCESSFUL PROGRAM LOAD
IPL1030   FILE NAME :  DUMPX
IPL1080   SOLOS LINKAGE COMPLETE
IPL1090   ENTER SYSTEM DATE (MM/DD/YY)
02/22/79
IPL1099   SYSTEM IPL NOW COMPLETE

SYSTEM CUSTOM COMMANDS

AL              :  WILL EXECUTE ALS-8 ASSEMBLER
BA              :  WILL EXECUTE BASIC INTERPRETER
DX ADDR1 ADDR2  :  WILL DUMP MEMORY IN HEX ASCII FORM
```

Example 1. List of SIMPL messages from standard IPL.

The System Date

The last thing SIMPL does is to ask the operator for the system date. This is usually the current date and is entered in MM/DD/YY format. Be sure to include the slashes. The program will accept any eight characters for the system date and make no check to see if it is

valid. These eight bytes are stored in a free area of memory protected from BASIC. In my system, I keep the system date at C812H to C819H; however, it can be put anywhere.

Once the IPL is complete, this date is available to BASIC programs using the PEEK command, as shown in Example 2, or to assembly-language routines. I have found this convenient; I use the system date often in dating listings, reports and as the current date in my biorhythm program.

```
9000 REM*  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
9010 REM*        SUBROUTINE TO GET SYSDATE
9020 REM*
9030 REM*  SYSDATE IS STORED AT 51218 TO 51225 (DECIMAL)
9040 REM*  D9$ WILL HOLD SYSDATE IN MM/DD/YY FORMAT
9050 REM*  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
9060 FOR X=51218 TO 51225
9070   LET D9$=D9$+CHR(PEEK(X))
9080 NEXT X
```

Example 2. BASIC subroutine to access the system date.

Changes

The program listing is assembled to run at location 4C00H, well above my BASIC. It can be reassembled to run at any location where you have 32FH free bytes of memory. Be sure that no program or file on the IPL tape will load into the same location, or SIMPL will be wiped out when that file is loaded on top of it.

To save memory and work, SIMPL makes use of four routines found in my monitor: RDBLK, which loads a file from tape and returns with the carry flag set if an error is encountered; SINP, which outputs the character in register B to the screen; SOUT, which returns a byte from the keyboard to register A or a zero flag if no key was pressed; and CRLF, which sends a carriage return and line feed to the screen, causing the cursor to skip to the next line. These routines are common functions that can be found in most monitors.

In lines 390 through 400 I send a hex 0B to the screen. On any system with the Processor Technology VDM-1 display board, this will cause the screen to clear. If you do not have the VDM-1, substitute the corresponding character for your system, or if you do not know it, you can delete these two lines altogether.

Conclusion

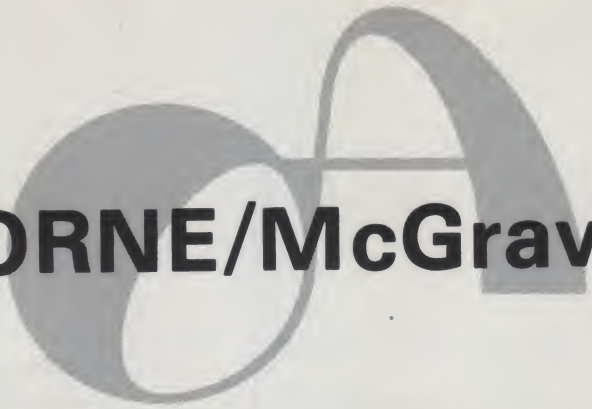
Programming is certainly less of a problem now. I can let SIMPL do the work of loading and linking my system. I find I have more time to look through *Microcomputing* or meditate on the joys of structured programming. Computers should be simple—SIMPL is my contribution toward that goal. ■

Program listing.

```
4C00                    0010 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C00                    0020 *
4C00                    0030 *                    SIMPL
4C00                    0040 *          Solos Initial Multiple Program Load
4C00                    0050 *        Written by Hal Combs ... March 25, 1978
4C00                    0060 *
4C00                    0070 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C00                    0080 *
4C00                    0090 *       SIMPL  will load all programs from the IPL
4C00                    0100 *       tape into memory until a file named "END"
4C00                    0110 *       is found.  The "END" file is loaded so it
4C00                    0120 *       should be a dummy file.
4C00                    0130 *       After all files are loaded SIMPL will link
4C00                    0140 *       desired programs to the SOLOS monitor by
4C00                    0150 *       inserting appropriate entries in the SOLOS
4C00                    0160 *       custom command table.
4C00                    0170 *
4C00                    0180 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C00                    0190 *
4C00                    0200 *       The following programs are on my IMPL tape.
4C00                    0210 *
4C00                    0215 *  1.  S.I.M.P.L.
4C00                    0220 *  2.  PROCESSOR TECHNOLOGY CASSET EXTENDED BASIC
4C00                    0230 *  3.  PROCESSOR TECHNOLOGY ALS-8 MONITOR/ASSEMBLER
4C00                    0240 *  4.  HAL COMBS'S HEX-ASCII MEMORY DUMPER
4C00                    0245 *  5.  DUMMY FILE `END'
4C00                    0250 *
4C00                    0260 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C00                    0270 *  The new SOLOS custom commands are :
4C00                    0280 *
4C00                    0290 *  Command : BA  executes  BASIC
4C00                    0300 *  Command : AL  executes  ALS-8
4C00                    0310 *  Command : DX  executes  DUMPX
4C00                    0320 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C00                    0330 *
4C00                    0340 *          PROGRAM CONTROL SECTION
4C00                    0350 *
4C00 C5                 0360 SIMPL  PUSH   B        SAVE THE REGISTERS
4C01 D5                 0370        PUSH   D
4C02 E5                 0380        PUSH   H
4C03 06 0B              0390        MVI    B,0BH    CLEAR SCREEN
4C05 CD 19 C0           0400        CALL   SOUT     SOLOS OUTPUT ROUTINE
4C08 CD C9 4C           0430        CALL   MSAGE    PRINT MESSAGE 1
4C0B CD C9 4C           0440        CALL   MSAGE    PRINT MESSAGE 2
4C0E CD F9 C2           0450        CALL   CRLF     SKIP 1 LINE
4C11 CD C9 4C           0460        CALL   MSAGE    PRINT IPL1010
4C14 CD 4D 4C           0470 TLOOP  CALL   TLOAD    GET NEXT FILE ON TAPE
4C17 3A FB 4C           0480        LDA    EFLAG    GET END-FILE FLAG
4C1A FE FF              0490        CPI    0FFH     IF FLAG = HEX FF
4C1C CA 28 4C           0500        JZ     LINKS    STOP TAPE LOADING
4C1F CD C9 4C           0510        CALL   MSAGE    PRINT IPL1030
4C22 CD C9 4C           0520        CALL   MSAGE    PRINT IPL1040
4C25 C3 14 4C           0530        JMP    TLOOP    GET NEXT FILE
4C28 CD B9 4C           0540 LINKS  CALL   SLINK    LINK TO SOLOS
4C2B CD C9 4C           0550        CALL   MSAGE    PRINT IPL1090
4C2E CD E2 4C           0560        CALL   SDATE    GET SYSTEM DATE
4C31 CD F9 C2           0570        CALL   CRLF     SKIP 1 LINE
4C34 CD C9 4C           0580        CALL   MSAGE    PRINT SYS-COMMANDS
4C37 CD F9 C2           0590        CALL   CRLF     SPACE A LINE
4C3A CD C9 4C           0600        CALL   MSAGE    PRINT NEW CUSTOM COMMANDS
4C3D CD F9 C2           0610        CALL   CRLF
4C40 CD C9 4C           0620        CALL   MSAGE
4C43 CD C9 4C           0630        CALL   MSAGE
4C46 CD C9 4C           0640        CALL   MSAGE
4C49 E1                 0670 ENDIT  POP    H        RESTORE REGISTERS
4C4A D1                 0680        POP    D
4C4B C1                 0690        POP    B
4C4C C9                 0700        RET    .        GOBACK
4C4D                    0710 *
4C4D                    0720 *          SUBROUTINES FOLLOW
4C4D                    0730 *
4C4D                    0740 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C4D                    0750 *       TLOAD - GETS NEXT TAPE FILE INTO MEMORY
4C4D                    0760 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4C4D 21 1C C8           0770 TLOAD  LXI    H,THDR   POINT TO TAPE HEADER
4C50 11 00 00           0780        LXI    D,0H     SET LOAD ADDR. = HEADER ADDR.
4C53 3E 80              0790        MVI    A,80H    SET FOR TAPE #1  AT 1200 BAUD
4C55 CD 13 C0           0800        CALL   RDBLK    SOLOS TAPE READ ROUTINE
4C58 DA A0 4C           0810        JC     ERROR    TAPE READ ERROR
4C5B 21 1C C8           0820        LXI    H,THDR   POINT TO TAPE HEADER
4C5E 7E                 0830        MOV    A,M      GET FIRST LETTER OF FILE NAME
4C5F FE 45              0840        CPI    45H      IS IT "E" ?
4C61 C2 7F 4C           0850        JNZ    TPMSG    NO ...
4C64 23                 0860        INX    H
4C65 7E                 0870        MOV    A,M      GET NEXT LETTER
4C66 FE 4E              0880        CPI    4EH      IS IT "N" ?
4C68 C2 7F 4C           0890        JNZ    TPMSG    NO ...
4C6B 23                 0900        INX    H
4C6C 7E                 0910        MOV    A,M      GET THIRD LETTER
4C6D FE 44              0920        CPI    44H      IS IT "D" ?
4C6F C2 7F 4C           0930        JNZ    TPMSG    NO ...
4C72 23                 0940        INX    H
4C73 7E                 0950        MOV    A,M      GET FOURTH LETTER
4C74 FE 00              0960        CPI    00H      IS IT " " ?
4C76 C2 7F 4C           0970        JNZ    TPMSG    NO ... THEN GO ON
4C79 3E FF              0980        MVI    A,0FFH   FOUND "END" FILE
4C7B 32 FB 4C           0990        STA    EFLAG    SET END-FILE FLAG
4C7E C9                 1000        RET    .        GOBACK
4C7F 21 68 4D           1010 TPMSG  LXI    H,TMSG   GET TMSG ADDRESS
4C82 22 FC 4C           1020        SHLD   MPTR     PUT IT IN MSG POINTER
4C85 21 A3 4D           1030        LXI    H,TPTR+25  CLEAR LAST 3 POS OF FILE NAME
4C88 36 20              1040        MVI    M,20H
4C8A 23                 1050        INX    H
4C8B 36 20              1060        MVI    M,20H
4C8D 23                 1070        INX    H
4C8E 36 20              1080        MVI    M,20H
4C90 11 A1 4D           1090        LXI    D,TPTR+23   POINT TO FILE NAME POS IN LINE
4C93 21 1C C8           1100 TMOVE  LXI    H,THDR   POINT TO TAPE HEADER
4C96 7E                 1110 PLOOP  MOV    A,M      MOVE FILE NAME TO LINE
4C97 FE 00              1120        CPI    00H      ENDING WITH 00 HEX
4C99 C8                 1130        RZ     .
4C9A 12                 1140        STAX   D
4C9B 23                 1150        INX    H
4C9C 13                 1160        INX    D
4C9D C3 96 4C           1170        JMP    PLOOP
4CA0                    1180 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4CA0                    1190 *       ERROR - TAPE READ ERROR ROUTINE
4CA0                    1200 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4CA0 11 E3 4E           1210 ERROR  LXI    D,ERMSG+35   POINT TO ERROR MESSAGE FILE FLD
4CA3 CD 93 4C           1220        CALL   TMOVE    MOVE FILE NAME TO ERR LINE
4CA6 21 C0 4E           1230        LXI    H,ERMSG  POINT TO ERROR MESSAGE
4CA9 22 FC 4C           1240        SHLD   MPTR     PUT IT IN MESSAGE POINTER
4CAC CD C9 4C           1250        CALL   MSAGE    PRINT IPL1501
4CAF CD C9 4C           1260        CALL   MSAGE    PRINT IPL1502
4CB2 CD C9 4C           1270        CALL   MSAGE    PRINT IPL1503
4CB5 C1                 1280        POP    B        REMOVE RETURN ADDRESS
4CB6 C3 49 4C           1290        JMP    ENDIT
4CB9                    1300 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4CB9                    1310 *       SLINK - BUILD SOLOS LINKAGE
4CB9                    1320 *  *  *  *  *  *  *  *  *  *  *  *  *  *  *  *
4CB9 21 00 4D           1330 SLINK  LXI    H,LDATA  POINT H-L TO LINK-DATA
4CBC 11 3C C8           1340        LXI    D,CTBL   POINT D-E TO CUSTOM TABLE
4CBF 7E                 1350 CLOOP  MOV    A,M
4CC0 FE FF              1360        CPI    0FFH     END OF CUSTOM TABLE ?
4CC2 C8                 1370        RZ     .        YES ... RETURN
4CC3 12                 1380        STAX   D        LOAD INTO CUSTOM COMMAND TABLE
4CC4 23                 1390        INX    H
4CC5 13                 1400        INX    D
4CC6 C3 BF 4C           1410        JMP    CLOOP
```

```
4CC9                    1420 *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
4CC9                    1430 *        MSAGE - PRINT MESSAGE ON SCREEN
4CC9                    1440 *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
4CC9 2A FC 4C           1450 MSAGE  LHLD    MPTR      PUT MESSAGE POINTER IN H-L
4CCC 46                 1460 MLOOP  MOV     B,M       GET CHARACTER
4CCD CD 19 C0           1470        CALL    SOUT      SOLOS OUTPUT ROUTINE
4CD0 78                 1480        MOV     A,B
4CD1 FE 00              1490        CPI     00H       IS IT END OF MESSAGE? (00 HEX)
4CD3 CA DA 4C           1500        JZ      MSEND     THEN GOTO MESSAGE END
4CD6 23                 1510        INX     H
4CD7 C3 CC 4C           1520        JMP     MLOOP
4CDA 23                 1530 MSEND  INX     H         POINT TO NEXT MESSAGE
4CDB 22 FC 4C           1540        SHLD    MPTR      SAVE POINTER
4CDE CD F9 C2           1550        CALL    CRLF      SKIP 1 LINE
4CE1 C9                 1560        RET       .
4CE2                    1570 *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
4CE2                    1580 *        SDATE - GET SYSTEM DATE
4CE2                    1590 *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
4CE2 CD C9 4C           1600 SDATE  CALL    MSAGE     ASK FOR SYSTEM DATE
4CE5 2A FE 4C           1610        LHLD    DPTR      GET SDATE POINTER IN H-L
4CE8 0E 08              1620        MVI     C,8       MAX CHARACTERS ACCEPTED
4CEA CD 1F C0           1630 SLOOP  CALL    SINP      SOLOS KEYBOARD INPUT
4CED CA EA 4C           1640        JZ      SLOOP     WAIT FOR INPUT
4CF0 47                 1650        MOV     B,A       PUT CHARACTER IN REG. B
4CF1 70                 1660        MOV     M,B       STORE IT
4CF2 CD 19 C0           1670        CALL    SOUT      SOLOS OUTPUT ROUTINE
4CF5 0D                 1680        DCR     C
4CF6 C8                 1690        RZ        .       LAST ONE?
4CF7 23                 1700        INX     H
4CF8 C3 EA 4C           1710        JMP     SLOOP
4CFB                    1720 *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
4CFB                    1730 *          DATA AREAS
4CFB                    1740 *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
4CFB                    1750 CRLF   EQU     0C2F9H    SOLOS CARRIAGE RETURN & LINE FEED
4CFB                    1760 THDR   EQU     0C81CH    SOLOS TAPE HEADER
4CFB                    1770 CTBL   EQU     0C83CH    SOLOS CUST TABLE
4CFB                    1775 SINP   EQU     0C01FH    SOLOS KEYBOARD INPUT
4CFB                    1780 SOUT   EQU     0C019H    SOLOS SCREEN OUTPUT
4CFB                    1785 RDBLK  EQU     0C013H    SOLOS TAPE READ
4CFB 00                 1790 EFLAG  DB      00H       END-FILE FLAG
4CFC 0D 4D              1800 MPTR   DW      MESSAGE   MESSAGE POINTER
4CFE 12 C8              1810 DPTR   DW      0C812H    SYSDATE POINTER
4D00                    1820 LDATA  EQU     $         SOLOS LINKAGE DATA TABLE
4D00 41 4C              1830        ASC     "AL"      ALS8 CUSTOM NAME
4D02 60 E0              1840        DW      0E060H    ALS8 LINKAGE ADDRESS
4D04 42 41              1850        ASC     "BA"      BASIC CUSTOM NAME
4D06 00 00              1860        DW      0000H     BASIC LINKAGE ADDRESS
4D08 44 58              1870        ASC     "DX"      DUMPX CUSTOM NAME
4D0A 00 C9              1880        DW      0C900H    DUMPX LINKAGE ADDRESS
4D0C FF                 1890        DB      0FFH      END OF LINKAGE TABLE
4D0D                    1900 MESSAGE EQU    $       * * MESSAGE TEXT AREA * *
4D0D 20 20 20 20        1910        ASC     "          S.I.M.P.L."
     20 20 20 20
     20 20 20 53
     2E 49 2E 4D
     2E 50 2E 4C
     2E
4D22 00                 1920        DB      00H
4D23 53 6F 6C 6F        1930        ASC     "Solos Initial Multiple Program Load"
     73 20 49 6E
     69 74 69 61
     6C 20 4D 75
     6C 74 69 70
     6C 65 20 50
     72 6F 67 72
     61 6D 20 4C
     6F 61 64
4D46 00                 1940        DB      00H
4D47 49 50 4C 31        1950        ASC     "IPL1010   IPL  NOW  IN  PROGRESS"
     30 31 30 20
     20 20 49 50
     4C 20 20 4E
     4F 57 20 20
     49 4E 20 20
     50 52 4F 47
     52 45 53 53
4D67 00                 1960        DB      00H
4D68 49 50 4C 31        1970 TMSG   ASC     "IPL1020   SUCCESSFUL PROGRAM LOAD"
     30 32 30 20
     20 20 53 55
     43 43 45 53
     53 46 55 4C
     20 50 52 4F
     47 52 41 4D
     20 4C 4F 41
     44
4D89 00                 1980        DB      00H
4D8A 49 50 4C 31        1990 TPTR   ASC     "IPL1030   FILE NAME :       "
     30 33 30 20
     20 20 46 49
     4C 45 20 4E
     41 4D 45 20
     3A 20 20 20
     20 20 20 20
4DA6 00                 2000        DB      00H
4DA7 49 50 4C 31        2010        ASC     "IPL1080   SOLOS LINKAGE COMPLETE"
     30 38 30 20
     20 20 53 4F
     4C 4F 53 20
     4C 49 4E 4B
     41 47 45 20
     43 4F 4D 50
     4C 45 54 45
4DC7 00                 2020        DB      00H
4DC8 49 50 4C 31        2030        ASC     "IPL1090   ENTER SYSTEM DATE (MM/DD/YY)"
     30 39 30 20
     20 20 45 4E
     54 45 52 20
     53 59 53 54
     45 4D 20 44
     41 54 45 20
     28 4D 4D 2F
     44 44 2F 59
     59 29
4DEE 00                 2040        DB      00H
4DEF 49 50 4C 31        2050        ASC     "IPL1099   SYSTEM IPL NOW COMPLETE"
     30 39 39 20
     20 20 53 59
     53 54 45 4D
     20 49 50 4C
     20 4E 4F 57
     20 43 4F 4D
     50 4C 45 54
     45
4E10 00                 2060        DB      00H
4E11 53 59 53 54        2070        ASC     "SYSTEM CUSTOM COMMANDS"
     45 4D 20 43
     55 53 54 4F
     4D 20 43 4F
     4D 4D 41 4E
     44 53
4E27 00                 2080        DB      00H
4E28 41 4C 20 20        2090        ASC     "AL             :  WILL EXECUTE ALS-8 ASSEMBLER
     20 20 20 20
     20 20 20 20
     20 20 20 20
     3A 20 20 57
     49 4C 4C 20
     45 58 45 43
     55 54 45 20
     41 4C 53 2D
     38 20 41 53
     53 45 4D 42
     4C 45 52
4E57 00                 2100        DB      00H
4E58 42 41 20 20        2110        ASC     "BA             :  WILL EXECUTE BASIC INTERPRETER
     20 20 20 20
     20 20 20 20
     20 20 20 20
     3A 20 20 57
     49 4C 4C 20
     45 58 45 43
     55 54 45 20
     42 41 53 49
     43 20 49 4E
     54 45 52 50
     52 45 54 45
     52
4E89 00                 2120        DB      00H
4E8A 44 58 20 41        2130        ASC     "DX ADDR1 ADDR2  :  WILL DUMP MEMORY IN HEX ASCII FORM
     44 44 52 31
     20 41 44 44
     52 32 20 20
     3A 20 20 57
     49 4C 4C 20
     44 55 4D 50
     20 4D 45 4D
     4F 52 59 20
     49 4E 20 48
     45 58 20 41
     53 43 49 49
     20 46 4F 52
     4D
4EBF 00                 2140        DB      00H
4EC0                    2150 ERMSG  EQU     $
4EC0 49 50 4C 31        2160        ASC     "IPL1501   TAPE READ ERROR - FILE :       "
     35 30 31 20
     20 20 54 41
     50 45 20 52
     45 41 44 20
     45 52 52 4F
     52 20 2D 20
     46 49 4C 45
     20 3A 20 20
     20 20 20 20
     20
4EE9 00                 2170        DB      00H
4EEA 49 50 4C 31        2180        ASC     "IPL1503   * * * IPL ABORTED * * *"
     35 30 33 20
     20 20 2A 20
     2A 20 2A 20
     49 50 4C 20
     41 42 4F 52
     54 45 44 20
     2A 20 2A 20
     2A
4F0B 00                 2190        DB      00H
4F0C 49 50 4C 31        2200        ASC     "IPL1505   REWIND TAPE & RETRY IPL"
     35 30 35 20
     20 20 52 45
     57 49 4E 44
     20 54 41 50
     45 20 26 20
     52 45 54 52
     59 20 49 50
     4C
4F2D 00                 2210        DB      00H

CLOOP   4CBF    1410
CRLF    C2F9    0450 0570 0590 0610 1550
CTBL    C83C    1340
DPTR    4CFE    1610
EFLAG   4CFB    0480 0990
ENDIT   4C49    1290
ERMSG   4EC0    1210 1230
ERROR   4CA0    0810
LDATA   4D00    1330
LINKS   4C28    0500
MESSA   4D0D    1800
MLOOP   4CCC    1520
MPTR    4CFC    1020 1240 1450 1540
MSAGE   4CC9    0430 0440 0460 0510 0520 0550 0580 0600 0620 0630 0640
                1250 1260 1270 1600
MSEND   4CDA    1500
PLOOP   4C96    1170
RDBLK   C013    0800
SDATE   4CE2    0560
SINPL   4C00
SINP    C01F    1630
SLINK   4CB9    0540
SLOOP   4CEA    1640 1710
SOUT    C019    0400 1470 1670
THDR    C81C    0770 0820 1100
TLOAD   4C4D    0470
TLOOP   4C14    0530
TMOVE   4C93    1220
TMSG    4D68    1810
TPMSG   4C7F    0850 0890 0930 0970
TPTR    4D8A    1030 1090
```



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Pig Latin

Maybe you could use this for program protection.

```
5 REM LIST VOWELS AND ENDING CHARACTERS
10 FOR I=1 TO 5: READ V$(I): NEXT
20 DATA A,E,I,O,U
30 FOR I=1 TO 5: READ EC$(I): NEXT
40 DATA ".", ";", "?", "!", " "
50 DIM L$(100): DIM P$(100): W3$="AY": CR$="#"
60 TW=23: REM ADJUST TO YOUR TERMINAL WIDTH
70 PRINT:PRINT:PRINT:PRINT:PRINT
71 PRINT TAB(6); "AUTOMATED"
72 PRINT
73 PRINT TAB(7); "LANGUAGE"
74 PRINT
75 PRINT TAB(5); "TRANSLATION"
76 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
77 PRINT TAB(6); "PIG LATIN"
78 PRINT:PRINT
79 PRINT "ENTER LINE TO BE TRANSLATED:"
80 PRINT:PRINT
99 REM GET INPUT
100 LC=-1: BW=1: INPUT L$
105 REM READY FOR FULL TEXT?
110 IF L$="/" OR L$="?" THEN 1000
115 REM CRLF
120 P$(N)=CR$: N=N+1
125 REM TAKE L$ ONE CHARACTER AT A TIME
130 FOR A=1 TO LEN(L$)
140 L1$=MID$(L$,A,1)
145 REM FIND FIRST VOWEL AND ENDING CHARACTER
150 FOR B=1 TO 5
160 IF L1$ <>EC$(B) OR BW <> A THEN 165
161 BW=BW+1: P$(N-1)=P$(N-1)+L1$: GOTO 210
165 IF LC<> -1 THEN 180
170 IF L1$=V$(B) THEN LC=A-BW
175 IF L1$="Y" AND A > BW THEN LC=A-BW
180 IF L1$=EC$(B) THEN EW=A: W4$=EC$(B): GOTO 500
190 NEXT B
200 IF A=LEN(L$) THEN EW=A+1: W4$=EC$(5): GOTO 500
210 NEXT A
220 PRINT:PRINT:PRINT: GOTO 100
499 REM TRANSLATE AND PRINT EACH INPUT
500 W$=MID$(L$,BW,EW-BW)
510 IF LC < 1 THEN P$(N)=W$+W3$+W4$: GOTO 550
520 W1$=RIGHT$(W$,LEN(W$)-LC)
530 W2$=LEFT$(W$,LC)
540 P$(N)=W1$+W2$+W3$+W4$
550 PRINT P$(N);
560 N=N+1: BW=EW+1: LC=-1
570 GOTO 210
999 REM FULL TEXT TRANSLATION
1000 CC=0
1010 FOR C=1 TO N-1
1020 IF P$(C)=CR$ THEN PRINT: GOTO 1050
1030 IF CC+LEN(P$(C)) > TW THEN CC=0: PRINT
1040 PRINT P$(C);
1050 CC=CC+LEN(P$(C))
1060 NEXT C
1070 IF L$="/" THEN 1090
1080 PRINT: GOTO 100
1090 END
```

Program listing.

Here is the world's first full-function language-translation program ever to be released to the public domain in 8K BASIC! With this powerful, albeit porcine, program you can select almost any text for translation: insurance policies, nursery rhymes, Joyce's *Ulysses*, names of organic chemicals, lyrics to rock ballads, programming tutorials . . . whatever! Your mighty micro will study, labor and haltingly print out a faithful translation of your text in pure ASCII Pig Latin.

Pig Latin is normally associated with the English language. However, in what may be a linguistic milestone, this program will pig-latinize *any* language that can be written with the ASCII character set. A text may even be input in Pig Latin. In that case, the translation will be rendered in (Pig Latin)^2.

For the uninitiated, Pig Latin is a "language" used by older people who don't want to be understood by younger people. It is a sort of secret language. But the security on this secret is so miserable that the "older" people may be only six or seven years of age. Nevertheless, Pig Latin continues to be passed along from generation to generation.

In the absence of a national academy to guard the purity of Pig Latin, some minor variations do exist. It is generally agreed, however, that the principal syntactical principle (Whew! Hereinafter called the PSP) is to move any consonants at the beginning of a word to the end of that word and add "ay." Hence, "scram" becomes "amscray" and "nix" becomes "ixnay."

BASIC Bacon

Beyond the PSP the rules seem rather loose. Lacking a HANG LOOSE mode in my BASIC interpreter, I was forced to establish a few reasonable rules:

1. Every word gets pig-latinized. (Some users exempt articles and other short words.)
2. Words beginning with vowels are translated simply by adding "ay."
3. "Y" is sometimes a vowel. Whether "y" is or is not a vowel is a matter of pronunciation, a skill most micros do not possess. The following rules work well enough.

A. A "y" that is the first letter of a word will be considered a consonant. This is fine for "you," "yes" and "yogurt." I will apologize to "Ypsilanti" but let us try to accept the adverse effect on "yttrium."

B. A "y" after the first letter of a word will be considered a vowel. This ensures the deluxe treatment for "by," "sly," "try," as well as "byte" and "Styx."

Pearls (i.e., Strings) Before Swine

The program is written in Microsoft 8K BASIC (OSI 6502 version) and should be directly loadable in many systems. Naturally, it depends on string functions. If you haven't had much use for these, or if you are adapting the program to other BASICs, it may help to know: LEN(A$) returns the length of string A$ in characters; LEFT$(A$,I) returns I characters beginning at the left of A$; RIGHT$(A$,I) returns the last I characters at the right of A$; MID$(A$,I,J) returns a sub-string beginning at the Ith character and continuing right for a total of J characters.

Running the program is simple. After the title there is a request for input. After each input there is an immediate translation followed by a request for more input. When the entire text has been entered, a separate input of either "?" or "/" will produce a printing of all Pig

Latin text from the current run without intervening English. If "?" is entered, additional input will be requested. On "/" the program ends.

The program accepts a series of words as input. Pig Latin, however, operates on individual words. So the program must isolate the separate words (by looking for ending characters, either a space or certain punctuation).

Also, the word must be examined for consonants on the left end. We do this by looking for vowels since there are fewer to look for. We call the word W$, the left consonants W2$, the rest of the word W1$; the "ay" (from the PCP) is W3$, and the ending character is W4$. When W1$ through W4$ are assembled in numerical order, we have the translation. For the word "pig," see Fig. 1. Atthay isay igpay atinlay.

If the word begins with a vowel, the word itself, W$, replaces W1$ and W2$ in accordance with reasonable rule number two. This process was rigged so that the same procedure would apply if a "word" with no vowels was input.

The key to this process is the use of the variable LC (left consonants), which is set to −1 before each word is translated. If a word arrived at line 500 for translation and printing, and LC = −1, no vowels were found. If LC = 0, the first letter is a vowel. In either case, no attempt is made to find W1$ or W2$. LC = −1 is also the flag that stops the search for vowels once one has been found (see line 165).

The variable assignments are intended to be mnemonic in the hope that little explanation will be necessary. There are, however, a couple of spots that warrant some help.

Note that the decision to start translation and printing is made in line 180 when an ending character is found. If none is found the word will never be translated. This can occur if the last character in an input is a letter. Line 200 saves that word by supplying an ending character.

No POKEs in This Pig

Line 160 is, frankly, a patch. Consider the word "yes!!!" Up to the first exclamation, everything is fine. The second and third exclamation points begin and end words all by themselves. It comes out "esyay!ay! ay!" Line 160 retroactively adds these ending characters to the end of the preceding word and starts the current word one character later. Since the preceding word has already been printed, the results are not visible until the final printing.

In line 50, TW (terminal width) is set to 23. (Yep, that's my terminal width!) Change TW to equal the terminal width of your system.

There is a small amount of formatting in the final printing (beginning at line 1000). In line 120, CR$ (CRLF flag) is inserted into the Pig Latin word list P$(N) at the beginning of each input to keep the input lines separated. Line 1030 also checks to see if there is enough terminal width left before printing each word. If not, it prints a CRLF to avoid awkward word splitting at the right of the screen.

Although this program is short and can be loaded quickly, it runs rather slowly. This adds to the fun. It appears that your mighty micro is really sweating at last. Naturally, your input should omit commas and colons (they are too much for BASIC). Quotes should also be left out. They show up all over the place. (Cleaning that mess up was too much for me.) Try to input Baa Baa Black Sheep. The results are eirdway.■

Strings

V$(X)	A list of vowels (except y)
EC$(X)	A list of characters that end words
L$	A line of input
L1$	A single character from L$
P$(X)	The list of Pig Latin words
CR$	A flag in P$(X) used to output a CRFL
W$	A word extracted from L$ before translation
W1$	Remainder of W$ after left consonants are removed
W2$	The left consonants of W$
W3$	"AY"
W4$	The character that ended W$

Numerics

A,B,C,I	Loop counters
LC	The number of Left Consonants
BW	Nth character of L$ that begins the current word
EW	Nth character of L$ that ends the current word
N	Number of next word to be stored in P$(N)
CC	Count of Characters printed on current line
TW	Terminal Width

Table 1. Variable assignments.

W1$ +	W2$ +	W3$ +	W4$
ig	p	ay	(space)

Fig. 1.

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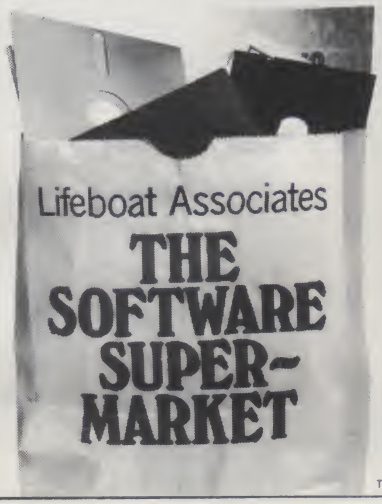
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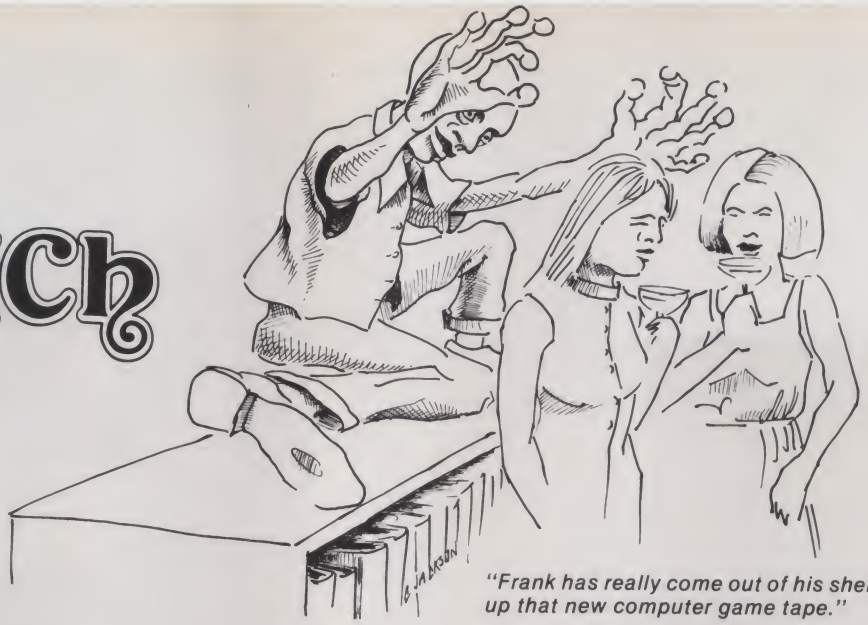
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Touch



"Frank has really come out of his shell since we picked up that new computer game tape."

```
                WELCOME TO THE GAME OF 'TOUCH'

IF THE LINE ABOVE APPEARS SHARP & CLEAR, YOU ARE NOT YET READY TO PLAY.
              (I.E. GO HAVE ANOTHER DRINK)


IF YOU ARE INDEED READY, YOU PROBABLY WON'T MIND GOING TO GATHER MORE PLAYERS.
AN EQUAL MIX OF MALES & FEMALES IS DESIRABLE (AT MOST PARTIES).

     ENTER A 'CR' WHEN READY TO CONTINUE :


THIS GAME GETS PEOPLE TO TOUCH EACH OTHER.  PEOPLE ACTUALLY LIKE TO TOUCH AND
BE TOUCHED.  UNFORTUNATELY OUR SOCIETY PUTS SOCIAL CONSTRAINTS ON PHYSICAL
CONTACT.  IN HONOR OF SOCIAL NORMS WE DUTIFULLY MAINTAIN OUR 'PERSONAL SPACES'.

.......WELL I DIRECT THIS GAME, AND I HAVE NO SOCIAL CONSCIENCE !.......
I WILL DIRECT EACH OF YOU, IN TURN, TO TOUCH ANOTHER PERSON IN A PARTICULAR WAY
(PUT THE BLAME ON ME).  YOU WILL HAVE APPROX. 5 SECONDS TO MAKE EACH CONTACT.
YOU THEN HOLD EACH OF YOUR PERSONAL CONTACTS UNTIL A NEW 'TOUCH' COMMAND
SUPERCEDES A PREVIOUS ONE.
THE FIRST PAIR TO 'BREAK' OR 'REFUSE' A CONTACT LOSES (YOU CHOOSE THE PENALTY).
TO MOMENTARILY INTERUPT A GAME, TYPE A 'CTL-B'; TO END, TYPE A 'CTL-C'
     ENTER A 'CR' WHEN READY TO CONTINUE :


HOW MANY MALES IN THE GROUP ?  3

HOW MANY FEMALES IN THE GROUP ?  3


NAME OF MALE NBR  1  ? TOM
NAME OF MALE NBR  2  ? BOB
NAME OF MALE NBR  3  ? TED

NAME OF FEMALE NBR  1  ? SHIRLEY
NAME OF FEMALE NBR  2  ? CAROL
NAME OF FEMALE NBR  3  ? ALICE


     ENTER A 'CR' WHEN READY TO CONTINUE :


***  TED   ***
PLACE YOUR REAR END ON ALICE 'S RIGHT KNEE

***  CAROL   ***
PLACE YOUR RIGHT FOOT ON TED 'S RIGHT THIGH

***  BOB   ***
PLACE YOUR RIGHT THIGH ON ALICE 'S LEFT EAR

***  ALICE   ***
PLACE YOUR LEFT FOREARM ON TOM 'S CHIN

***  BOB   ***
PLACE YOUR RIGHT HAND ON CAROL 'S CHEST

***  CAROL   ***
PLACE YOUR LEFT EAR ON BOB 'S LEFT THIGH

***  BOB   ***
PLACE YOUR FOREHEAD ON SHIRLEY 'S RIGHT KNEE

***  ALICE   ***
PLACE YOUR REAR END ON TED 'S RIGHT SHOULDER
```

Sample run.

Adrian R. Thornton
6404 Overton Road
Louisville KY 40228

My wife and I throw a couple of good-sized parties each year. On those occasions, our block becomes a parking lot; the kitchen, a bar; the living room, a dance floor; the bathrooms, a blur of activity; and the "computer room," a midway. The computer room usually contains a large enough crowd to make the fire marshall cringe; however, most of the people in there are either waiting in line for the computer, making a move on someone else at the party or simply can't get out of the room. Unfortunately, only two or three of the people in the room could actually get involved in most of the computer games at one time. That is, until Touch made its debut.

The Game

The following program, Touch, can involve the people in the computer room, the living room, the kitchen and the bathrooms, all at one time. Although as few as two people may play, the larger the number of participants, the more fun is the game.

Touch is a social game. The premise upon which it is based is that people like to touch and be touched by other people, and if it weren't for our social inhibitions (and the need to make a living), we might spend all our waking hours groping at each other. To overcome these social constraints we resort to liquor, dope, prostitution, and some even go so far as to get married.

Now Touch, combined with a moderate amount of alcohol, provides yet another, and more socially acceptable way of surmounting our social inhibitions. The computer decides which of the participants shall touch, and in what manner they shall touch each other. When the computer issues the touch command, the participants do not have to feel responsible for breaching each other's personal space; after all,

the computer made them do it! Touch provides a game-like atmosphere where the participants can relax and enjoy the feelings of personal contact they would normally feel restricted from enjoying.

The Program

The program is relatively simple. It runs sequentially through the following four steps:

1. Print game directions
2. Load the applicable body parts
3. Get all participants' names
4. Begin printing touch commands

Step four is an infinite loop, interruptible via CTL-B. This touch command loop alternately selects a male; then a female name randomly from the participant list M$. This selected participant is then directed to touch a randomly selected body part of his/hers to a randomly selected body part of a randomly selected participant of the opposite sex. There is a pause of about five seconds, during which the above pair of participants must attempt to complete the directed contact. They must maintain this contact until a later touch command supercedes this one, or until a pair of players breaks or refuses a contact, thus losing the game.

The above touch commands will continue to be issued until someone decides to temporarily halt the loop via CTL-B. When everyone is ready to begin again, a carriage return is entered, and the touch command loop continues from where it was interrupted.

The result is an uproarious mass of people frantically trying to satisfy and keep up with the computer's sometimes impossible touch commands. The game soon becomes as much fun to watch as it is to participate in.

Modifications

The program is easily modifiable to make it acceptable to a range of participants from your church group to the local swingers' club. The introduction given by the program is geared toward a party well under way. You may want to slant the introduction to a different type of group. The list of applicable body parts may also be altered. Simply change the data statements to reflect the level of intimacy you desire. Also reset the variable N1 in line number 290 to the current number of body parts defined by the data statements.

Touch was written on a Heathkit H8 using Extended Benton Harbor disk BASIC. The program coding is also compatible with the Heath Extended cassette BASIC. The printing of the introduction has been designed for the 12-line H9 CRT. You may want to change the screen holds (GOSUB 890) to be compatible with your terminal type. ■

```
00010 REM                <<<  TOUCH  >>>
00020 REM  < BY ADRIAN R. THORNTON, APRIL 1, 1979 >
00030 :
00040 :
00050 PRINT :PRINT :PRINT TAB(15);"WELCOME TO THE GAME OF 'TOUCH'"
00060 PRINT
00070 PRINT "IF THE LINE ABOVE APPEARS SHARP & CLEAR, YOU ARE NOT YET READY TO PLAY."
00080 PRINT TAB(15);"(I.E. GO HAVE ANOTHER DRINK)"
00090 PAUSE 3000
00100 PRINT :PRINT
00110 PRINT "IF YOU ARE INDEED READY, YOU PROBABLY WON'T MIND GOING TO GATHER MORE PLAYERS."
00120 PRINT "AN EQUAL MIX OF MALES & FEMALES IS DESIRABLE (AT MOST PARTIES)."
00130 PRINT :GOSUB 890
00140 PRINT :PRINT
00150 PRINT "THIS GAME GETS PEOPLE TO TOUCH EACH OTHER.  PEOPLE ACTUALLY LIKE TO TOUCH AND"
00160 PRINT "BE TOUCHED.  UNFORTUNATELY OUR SOCIETY PUTS SOCIAL CONSTRAINTS ON PHYSICAL"
00170 PRINT "CONTACT.  IN HONOR OF SOCIAL NORMS WE DUTIFULLY MAINTAIN OUR 'PERSONAL SPACES'."
00180 PRINT
00190 PRINT ".......WELL I DIRECT THIS GAME, AND I HAVE NO SOCIAL CONSCIENCE !......."
00200 PRINT "I WILL DIRECT EACH OF YOU, IN TURN, TO TOUCH ANOTHER PERSON IN A PARTICULAR WAY"
00210 PRINT "(PUT THE BLAME ON ME).  YOU WILL HAVE APPROX. 5 SECONDS TO MAKE EACH CONTACT."
00220 PRINT "YOU THEN HOLD EACH OF YOUR PERSONAL CONTACTS UNTIL A NEW 'TOUCH' COMMAND"
00230 PRINT "SUPERCEDES A PREVIOUS ONE."
00240 PRINT "THE FIRST PAIR TO 'BREAK' OR 'REFUSE' A CONTACT LOSES (YOU CHOOSE THE PENALTY)."
00250 PRINT "TO MOMENTARILY INTERUPT A GAME, TYPE A 'CTL-B'; TO END, TYPE A 'CTL-C'"
00260 GOSUB 890
00270 REM ------------------------------------------------------------------------------
00280 REM FOLLOWING IS THE LIST OF BODY PARTS (RATED PG)
00290 N1=29:REM NUMBER OF BODY PARTS, BELOW
00300 DATA "RIGHT FOOT","LEFT FOOT","RIGHT HAND","LEFT HAND"
00310 DATA "RIGHT KNEE","LEFT KNEE","RIGHT ELBOW","LEFT ELBOW"
00320 DATA "RIGHT SHOULDER","LEFT SHOULDER","RIGHT HIP","LEFT HIP"
00330 DATA "RIGHT THIGH","LEFT THIGH","RIGHT CALF","LEFT CALF"
00340 DATA "RIGHT FOREARM","LEFT FOREARM","RIGHT EAR","LEFT EAR"
00350 DATA "WAIST","NOSE","BACK","CHEST","BELLY BUTTON","LIPS"
00360 DATA "FOREHEAD","CHIN","REAR END"
00370 :
00380 DIM B$(N1),N(2)
00390 FOR I=0 TO N1-1:REM LOAD BODY PARTS
00400 READ B$(I)
00410 NEXT I
00420 PRINT :PRINT :CNTRL 0,890:REM SET CTL-B EXIT
00430 REM ------------------------------------------------------------------------------
00440 INPUT "HOW MANY MALES IN THE GROUP ?  ";N(1)
00450 PRINT
00460 INPUT "HOW MANY FEMALES IN THE GROUP ?  ";N(2)
00470 PRINT
00480 IF N(1)>0 AND N(2)>0 THEN 500
00490 PRINT "SORRY, NEED AT LEAST ONE OF EACH SEX":GOTO 440
00500 IF ABS(N(1)-N(2))/MAX(N(1),N(2))<.25 THEN 530
00510 IF N(1)<N(2) THEN PRINT "COULDN'T FIND ANY MORE GUYS, HUH ?  TOO BAD.":GOTO 530
00520 PRINT "COULDN'T FIND ANY MORE GIRLS HUH ?  TOO BAD."
00530 :
00540 REM GET NAMES OF PARTICIPANTS
00550 DIM M$(2,MAX(N(1),N(2))),T$(2)
00560 T$(1)="MALE":T$(2)="FEMALE"
00570 FOR K=1 TO 2
00580 PRINT
00590 FOR I=1 TO N(K)
00600 PRINT "NAME OF ";T$(K);" NBR ";I;" ";
00610 LINE INPUT ;M$(K,I)
00620 M$(K,I)=M$(K,I)+" "
00630 :
00640 REM CHECK FOR DUPLICATE NAMES
00650 FOR J=0 TO I-1
00660 IF M$(K,I)<>M$(K,J) THEN 700
00670 PRINT "THERE IS MORE THAN ONE ";M$(K,I)
00680 M$(K,I)=M$(K,I)+STR$(I):J=I-1
00690 PRINT T$(K);" NBR";STR$(I);"WILL BE IDENTIFIED AS '";M$(K,I);"'"
00700 NEXT J
00710 NEXT I
00720 NEXT K
00730 :
00740 PRINT :PRINT :GOSUB 890
00750 FOR I=1 TO 12:PRINT :NEXT I:REM CLEAR H-9 CRT
00760 REM ------------------------------------------------------------------------------
00770 T=2
00780 REM THE FOLLOWING IS THE TOUCH DIRECTOR ROUTINE
00790 T=ABS(T-3):REM FLIP-FLOP
00800 REM FOLLOWING IS COMMAND TO THE 'TOUCHER'
00810 PRINT "***  ";M$(T,INT(RND(1)*N(T))+1);"  ***"
00820 PAUSE 750
00830 REM FOLLOWING IS WHERE & WITH WHAT THE 'TOUCHER' IS TO TOUCH THE 'TOUCHEE'
00840 PRINT "PLACE YOUR ";B$(INT(RND(1)*N1));" ON ";M$(ABS(T-3),INT(RND(1)*N(ABS(T-3)))+1);
00850 PRINT "'S ";B$(INT(RND(1)*N1))
00860 PAUSE 3000:PRINT :GOTO 790
00870 REM ------------------------------------------------------------------------------
00880 REM CTL-B INTERUPT/SCREEN HOLD SUBROUTINE
00890 LINE INPUT "     ENTER A 'CR' WHEN READY TO CONTINUE :  ";C$
00900 RETURN
```

Program listing.

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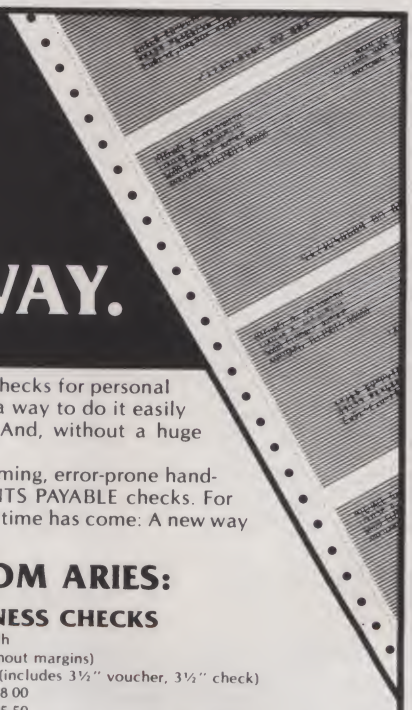
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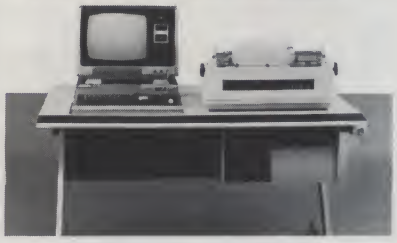
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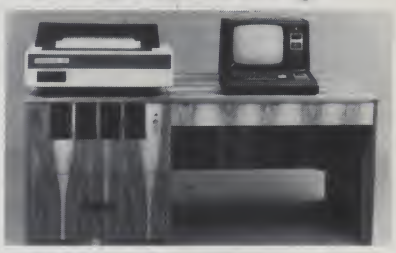
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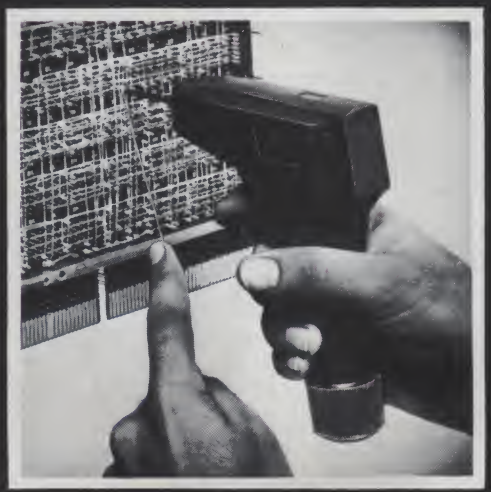
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Program Debugging: the Yellow-Brick-Road Approach

Programs sometimes misbehave. Return them to the right path with this program.

```
0038             0008   TTYOUT  EQU 0F09BH  PRINT REG. B      *
0038 C5          0010           PUSH B      SAVE REGISTERS
0039 D5          0020           PUSH D
003A E5          0030           PUSH H
003B 32 F0 D3    0035           STA TEMP1                     *
003E 06 41       0040           MVI B,'A'   REGISTER A
0040 CD 9B F0    0050           CALL TTYOUT                   *
0043 06 20       0060           MVI B,' '   ASCII SPACE
0045 CD 9B F0    0070           CALL TTYOUT                   *
0048 3A F0 D3    0080           LDA TEMP1   GET A             *
004B CD D3 F1    0090           CALL 0F1D3H PRINT A (HEX)     *
004E CD A6 F0    0095           CALL CRLF   PRINT CRLF        *
0051 06 48       0100           MVI B, 'H'  ASCII H
0053 CD 9B F0    0110           CALL TTYOUT                   *
0056 06 20       0120           MVI B, ' '  ASCII SPACE
0058 CD 9B F0    0130           CALL TTYOUT                   *
005B E1          0140           POP H       RESTORE H
005C E5          0145           PUSH H      SAVE L
005D 7C          0150           MOV A,H     GET H IN A
005E CD D3 F1    0160           CALL 0F1D3H PRINT IT          *
0061 E1          0170           POP H       RESTORE L
0062 7D          0180           MOV A,L     GET L  IN A
0063 CD D3 F1    0190           CALL 0F1D3H PRINT IT          *
0066 CD A6 F0    0200           CALL CRLF   PRINT CRLF        *
0069 06 44       0210           MVI B,'D'   ASCII D
006B CD 9B F0    0220           CALL TTYOUT                   *
006E 06 20       0230           MVI B,' '   ASCII SPACE
0070 CD 9B F0    0240           CALL TTYOUT                   *
0073 D1          0250           POP D       RESTORE D
0074 D5          0260           PUSH D      SAVE E
0075 7A          0270           MOV A,D     GET D IN A
0076 CD D3 F1    0280           CALL 0F1D3H PRINT IT          *
0079 D1          0290           POP D       RESTORE E
007A 7B          0300           MOV A,E     GET E IN A
007B CD D3 F1    0310           CALL 0F1D3H PRINT IT          *
007E CD A6 F0    0315           CALL CRLF   PRINT CRLF        *
0081 06 42       0320           MVI B,'B'   ASCII B
0083 CD 9B F0    0330           CALL TTYOUT                   *
0086 06 20       0340           MVI B,' '   ASCII SPACE
0088 CD 9B F0    0350           CALL TTYOUT                   *
008B C1          0360           POP B       RESTORE B
008C C5          0370           PUSH B      SAVE C
008D 78          0380           MOV A,B     GET B IN A
008E CD D3 F1    0390           CALL 0F1D3H PRINT IT          *
0091 C1          0400           POP B       RESTORE C
0092 79          0410           MOV A,C     GET C IN A
0093 CD D3 F1    0420           CALL 0F1D3H PRINT IT          *
0096 CD A6 F0    0430           CALL CRLF   PRINT CRLF        *
0099 06 53       0432           MVI B,'S'   ASCII S
009B CD 9B F0    0434           CALL TTYOUT                   *
009E 06 20       0436           MVI B,' '   ASCII SPACE
00A0 CD 9B F0    0438           CALL TTYOUT                   *
00A3 E1          0440           POP H       GET STACK IN HL
00A4 E5          0450           PUSH H      SAVE L
00A5 7C          0460           MOV A,H     GET H IN A
00A6 CD D3 F1    0470           CALL 0F1D3H PRINT MSB OF STACK*
00A9 E1          0480           POP H       RESTORE STACK TO H
00AA 7D          0490           MOV A,L     GET L IN A
00AB CD D3 F1    0500           CALL 0F1D3H PRINT IT          *
00AE C3 AE 00    0900   STOP     JMP STOP    FINISHED! LOOP HERE
00B1             1000   CRLF    EQU 0F0A6H  PRINTS CR, LF     *
00B1             1010   TEMP1   EQU 0F3F0H  SAVE A BYTE HERE  *
```

Listing 1. This routine prints the contents of all 8080 registers at the moment of entry. It uses three external subroutine calls: CRLF must print a carriage return and line feed, TTYOUT must print the contents of the B register in ASCII and 0F1D3H must print the contents of A as two ASCII hex bytes. Listing 2 will work for 0F1D3H. Lines ending with an asterisk may need minor changes from one system to another.

My computer used to ride frequent tornadoes into Munchkin land. I can always tell when this happens because the front panel lights start flashing as though they've just been "hexed" by the Wicked Witch of the West, and my terminal acts like a crystal ball with a short circuit.

If you've never had a program push your 8080 over the rainbow, to act as if it's doing ToTos rather than GoTos, or a hardware problem that made your programs "bomb," then you can skip this article. But if you occasionally find your assembly-language programs lost somewhere in the land of Oz, then you'll find lots of uses for a routine that will tell you how you got there.

Program Applications

Listing 1 is a "trap" routine that will print the contents of all of the 8080 registers at the moment of entry. In addition, the contents of the top of the stack are printed. I have found it very useful in debugging a program

```
0000             0000           *THIS PROGRAM CONVERTS REGISTER
0000             0001           *"A" GO ASCII HEXADECIMAL
0000             0002           *DIGITS AND PRINTS THEM. ALL
0000             0003           *REGISTERS ARE PRESERVED.
0000 C5          0012           PUSH B          SAVE REGISTERS
0001 D5          0013           PUSH D
0002 E5          0014           PUSH H
0003 32 FE FF    0020           STA TEMP2       SAVE BYTE     *
0006 E6 F0       0030           ANI 0F0H        GET 1ST NIBBLE
0008 1F          0032           RAR             SHIFT TO PLACE
0009 1F          0034           RAR
000A 1F          0036           RAR
000B 1F          0038           RAR
000C CD 26 00    0040           CALL CONVERT    MAKE IT ASCII
000F CD 9B F0    0050           CALL TTYOUT     PRINT IT      *
0012 3A FE FF    0060           LDA TEMP2       GET BYTE BACK *
0015 E6 0F       0070           ANI 0FH         GET 2ND NIBBLE
0017 CD 26 00    0080           CALL CONVERT    MAKE IT ASCII
001A CD 9B F0    0090           CALL TTYOUT     PRINT IT      *
001D E1          0110           POP H           RESTORE REG'S
001E D1          0120           POP D
001F C1          0130           POP B
0020 3A FE FF    0140           LDA TEMP2                     *
0023 C9          0150           RET             THAT'S ALL!
0024             0220           *THIS CONVERTS THE LEAST
0024             0222           *SIGNIFICANT NIBBLE OF "A"
0024             0224           *TO ASCII HEX AND PUTS THE
0024             0226           *RESULT IN "B".
0024 FE 0A       0250   CONVERT CPI 0AH         DIGIT OR LETTER?
0026 FA 2F 00    0260           JM NUMBER
0029 DE 09       0270           SBI 9           LETTER
002B F6 48       0280           ORI 40H
002D 47          0290           MOV B,A
002E C9          0300           RET
002F F6 30       0400   NUMBER  ORI 30H
0031 47          0410           MOV B,A
0032 C9          0420           RET
0033             0900   TTYOUT  EQU 0F09BH      PRINT REG "B" *
0033             0910   TEMP2   EQU 0FFFEH      STORE A BYTE  *
```

Listing 2. This program converts the bytes in register A to 2 ASCII hexadecimal bytes and prints the results. This routine references the external subroutine TTYOUT, which must print the contents of the B register in ASCII. Lines ending with asterisks may need minor modifications in different systems.

to insert jumps to this routine at strategic points to verify the operation of preceding algorithms.

The routine itself occupies 121 bytes and may be assembled anywhere in memory. It executes almost instantly and interfaces with a user-provided routine called TTYOUT, which must print the contents of the B register in ASCII. It makes extensive use of the stack for temporary storage and uses just one byte that cannot be ROM; the byte labeled TEMP1 has to be located somewhere in RAM.

The CALL 0F1D3H instruction is for owners of the Processor Technology software package one. This routine prints the value in the accumulator as two ASCII hexadecimal characters. If you don't have software package one or access to a routine to do this, then the routine in Listing 2 will work nicely.

A second useful application of this "yellow-brick-road" program is the result of certain hardware characteristics of the 8080 microprocessor. In most 8080 memory schemes, uninstalled memory blocks look like continuous bytes of hexadecimal FF to the processor. This corresponds to the RESTART 7 instruction, which amounts to the same thing as a CALL 0038 HEX sequence.

All of this means that whenever the processor gets lost and starts trying to execute programs in uninstalled memory, it will immediately be forced to continue execution at 0038 Hex. This is a very common occurrence, caused by program bugs or hardware addressing errors.

Now suppose that address 38 was the first instruction of "yellow brick road." Immediately, the errant automaton is brought under control and the programmer is alerted that something went wrong before his code is destroyed by the otherwise inevitable sequence of RST7 instructions pushing the stack through all of memory. Also, the contents of all of the registers at the moment of the error are recorded, which can help to find the return path back home from Oz.

Back in Kansas

Since I have no interrupting equipment that uses the RST7 instruction, I have found it useful to leave this yellow-brick-road routine at address 38 all the time. It has saved me hours of work more than once. By copying Listings 1 and 2 into your computer and properly interfacing them with your TTY routine, you'll benefit too. Now if someone would just find a way of implementing Glenda the Good. . . . ■

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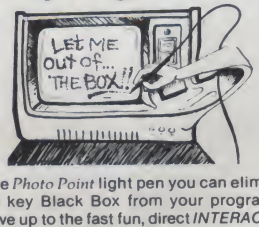
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To aid in debugging software, some system monitors have routines which can seize control from an operating program when the program reaches specified addresses known as breakpoints. Once the monitor is in control we can examine the contents of the CPU registers and tell (we hope) what the operating program was doing just before it was interrupted. Running a program until a specified test condition is met and then putting the CPU in suspended animation is also an effective technique for hardware testing.

There are at least two situations when it can be useful to temporarily suspend CPU operation so we can diagnose hardware problems. The first situation arises when we observe a system malfunction and deduce that information might have gotten onto a bus when it didn't belong there. The second situation is when we observe a system malfunction which suggests that information was not put on the bus when it should have been. In both cases it would be helpful to have an independent circuit keeping tabs on the system bus while programs were being run.

The circuit described here is an independent judge of system integrity which can continuously observe any eight leads of the system bus and compare the word present on those leads to a test word which we have specified. If the two words are ever the same the circuit informs us by lighting an LED indicator and immediately stops the CPU so we can investigate further. Once we have completed our diagnosis we can reset the circuit, and the program will continue on its way as if nothing happened.

Circuit Description

The circuit shown in Fig. 1 is designed using two 74LS85 digital comparators. Inputs to each comparator consist of two 4-bit words, or one byte. When the two 4-bit words are identical, the output (pin 6) will become a logic one provided that the control input (pin 3) is also a logic one. The control input permits us to operate the two comparators as a single 8-bit comparator by connecting the output of IC1 to the control input of IC2. (The control input of IC1 will be discussed below) Eight lines of the microcomputer bus, the ones we suspect are the troublemakers, form one of the 8-bit words, and the other input word is the test condition specified by the setting of switch S1.

Following the comparator is an inverter, IC3A, and an R/S latch, IC3B and IC3D. In normal operation, we first

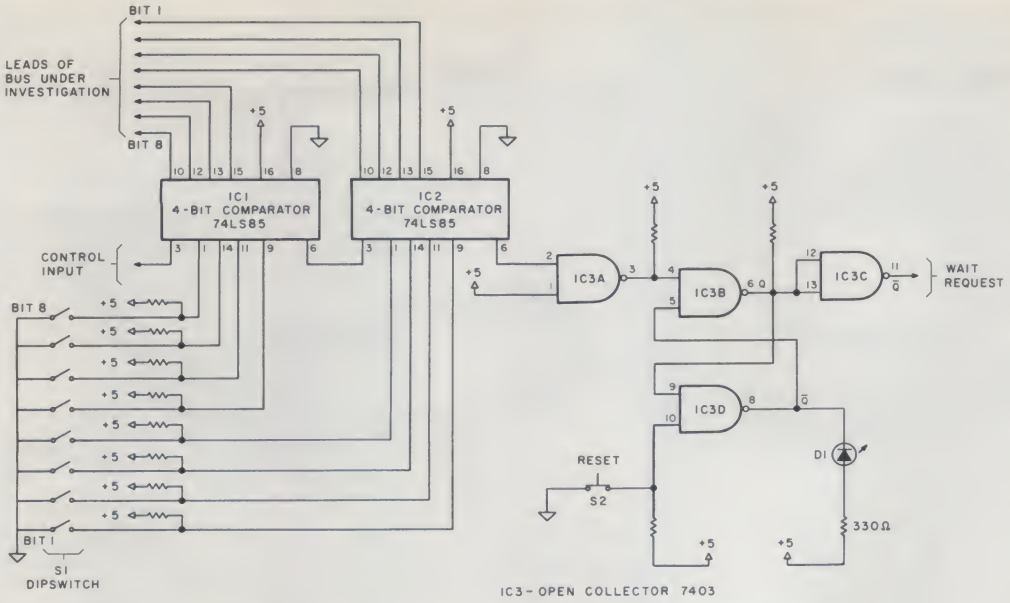


Fig. 1. Bus monitoring circuit. All resistors 10k unless otherwise indicated. D1 can be almost any LED.

reset the latch using push-button switch S2 so that the Q output is a logic zero, the $\overline{Q}$ output is a logic one, and the LED is extinguished. We then begin running a program. If the program results in the microcomputer bus assuming the same value as the test condition, the R/S latch will set, Q will become a logic one, $\overline{Q}$ will become a logic zero, and the LED will light. The latch will remain set until manually reset with S2.

Hold It Right There

An 8080 CPU can work with slow memory and I/O devices because it can be made to pause in wait states. When the CPU is in a wait state, address and data remain fixed on the system buses, so a wait state is an ideal time to do hardware troubleshooting. An 8080 can be put in a wait state by placing a logic zero on the Ready input (pin 12), but there are some timing restrictions which must be observed when using the Ready input. Most microcomputers already contain circuitry to satisfy the timing requirements. Usually this is done by synchronizing the Ready input with the system clock as shown in Fig. 2. The Wait Request (or similarly named) lead can then be controlled asynchronously, and it is this lead which is normally routed to all memory and I/O plug-in boards.

By connecting the $\overline{Q}$ output of our circuit to the Wait Request lead we can put the CPU into a wait state whenever the circuit decides that the bus leads it is watching are equivalent to the specified test word. The $\overline{Q}$ output is taken from inverter IC3C because Wait Request inputs must be open-collector gates. The CPU will stay in a wait state until our circuit is reset, so we can take as much time as we need to make hardware tests. Again, once the circuit reset button is pushed the CPU will continue from where it left off with no knowledge that it had been put in suspended animation.

One final aspect of the circuit design which deserves mention is the choice of Schottky (LS) devices for the digital comparators. Similar comparators are made in both standard TTL (7485) and low-power (74L85) versions. Most integrated circuit suppliers who advertise in *Microcomputing* carry only standard and Schottky TTL families. I chose Schottky devices because their input current is lower than standard TTL, so they cause less loading of the computer bus. If your computer bus has sufficient drive capability you can directly substitute the less expensive standard 7485 devices, or you can use the 74L85 devices for even less loading if you can find them.

The Control Input as a Qualifier

We can let the circuit look for glitches only at certain times by using the control input as a timing qualifier. For example, if we want to study information being read from memory we can connect the control input to the Memory Read (MEMR) lead of the system control bus. Our circuit will then respond only when the MEMR lead is a logic one. The control input may also be derived from peripheral plug-in circuits, such as a cassette interface, so it provides great flexibility in troubleshooting a wide variety of hardware problems.

If One Is Good, Two Is Better

Two such circuits can be used independently, for example, to observe both input and output data buses simultaneously. Or the two circuits can be tied together by connecting the control input of one circuit to the output of the second circuit. This arrangement is useful for observing a 16-bit address bus. Two of the clip leads are control inputs for the two circuits, one of the leads is the output Wait Request lead, and the other two leads bring 5 volts and ground to the circuit.

Check Your Addition

One of the best uses for the circuit is as an aid in checking out new hardware additions to the computer system. Imagine that you have just plugged a new video interface into your computer mainframe and it doesn't work. What do you do now? The video interface can't be tested easily by itself because it depends upon signals from the microcomputer. One way to find out what is, or isn't, happening is to run a program which outputs commands to the video interface and uses our circuit to stop the CPU as soon as the command is sent. We can then use a voltmeter or logic probe to trace the command through the video interface. ■

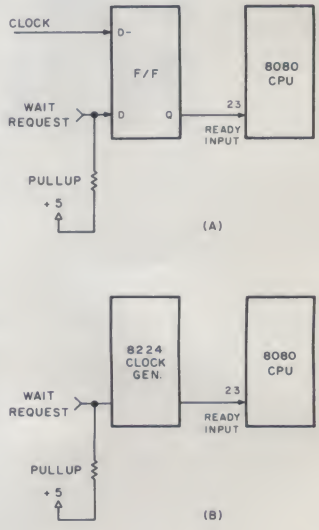


Fig. 2. There are two ways in which Wait Requests can be synchronized to the timing of an 8080 CPU: (a) shows the most common method using a flip-flop; (b) shows a method using the newer Intel 8224 clock generator with built-in synchronizing circuitry.

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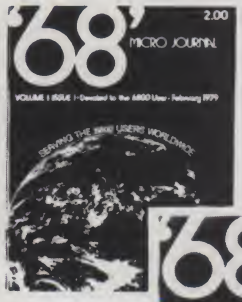


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Sweetening the Bytesaver

While the Bytesaver is an excellent value in its original form, its usefulness can be further enhanced by utilization of this modification.

The Cromemco Bytesaver is a useful addition to the circuit board repertoire of the owner of an S-100 bus system. Useful as both an 8K PROM card (eight 2708s) and as a programmer for same, it is a bargain at a kit price of $145. Its utility can be even further increased, however, by implementation of the technique shown here.



Photo 1. Front panel view of the Remote Programming Panel for the Cromemco Bytesaver, married to the author's Z-2D. The socket on the left, addressed at F800, is read-only; the one on the right, at FC00, is for programming. The metal switch handle is a useful ground point for the elimination of bodily static charge prior to insertion or removal of a 2708. (Photos by Douglas Fowley)

Remote Programming Panel

Perhaps the single most troublesome aspect of programming EROMs with the Bytesaver in its standard form is that it is necessary to power down the system, *unplug* the board and cycle the IC sockets during each iteration of the program/debug sequence. This can wear down both the connectors involved and the nerves of the user; in my case it led to the addition of a front-panel programming station connected to the Bytesaver by a ribbon cable.

The result is shown in Photo 1. The sockets chosen were the Tex-tool units (224-3344 with receptacles) . . . costly parts but the best around for the heavy-duty requirements of EROM programming. Standard 24-pin sockets would work—for a while. The switch between the sockets replaces the program power switch on the Bytesaver card.

Operation

Operation of the unit is simple: A 2708 is inserted in the socket on the right (addressed at FC00); the switch is turned on; and the DEBUG, ZM1 or BYTEMOVER software is directed to program the chip.

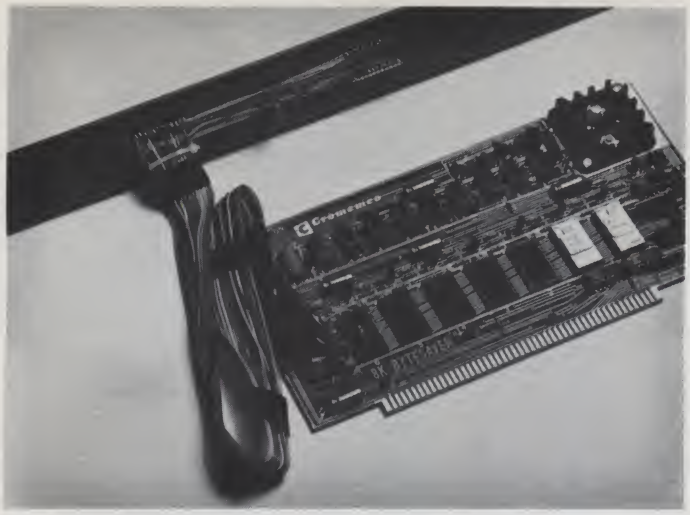


Photo 2. Complete Bytesaver/Panel assembly. Any number of sockets may be thus extended, but the usefulness of more than two is questionable. DIP headers on the circuit-board end of the cable allow separation for easy handling and installation. Electrical tape around the ribbon near the board prevents insulation puncture by IC pins on an adjacent PC board.

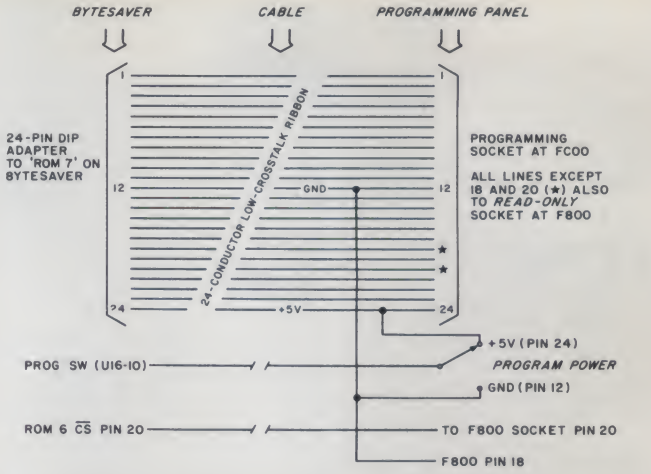


Fig. 1. Schematic shows simplicity of modification: note that the only differences between the two EROM sockets are pin 18 (PROGRAM) and pin 20 (CHIP SELECT). The former is grounded on the read-only socket, and the latter is connected to pin 20 on its corresponding socket on the board. The program power switch replaces the original

After programming, the switch is turned off.[1] The other socket position is provided on the panel to simplify copying data from one EROM to another; but this can be a two-stage affair via system RAM if you wish to keep socket costs to a minimum (the bill from the Tex-tool distributor was $34).

Modification

Photo 2 shows the details of the modification. Since the only difference between the wiring of the eight EROM sockets on the card lies in the source of the chip select signal, two front-panel sockets may be supported with a 24-line cable, plus one wire for the second select (pin 20).

A second additional wire is added to carry the status of the program power switch. To allow separation of the panel from the board and to simplify installation, the cable should be terminated in a 24-pin DIP header. The two troublesome piggyback lines, in order to be pluggable as well, terminate in a kludge comprising a bisected 14-pin header and a DIP socket glued sideways onto the EROM socket adjacent to the first one. The other six sockets on the Bytesaver are unaffected and may be used as originally intended.

The schematic in Fig. 1 shows how straightforward the modification is: Wiring of the circuit involves merely the extension of existing signals. The only precaution to be observed, aside from the avoidance of error, is keeping cable length at a minimum. Crosstalk in ribbon cable has a justifiably bad reputation, and there is bound to be some degradation of pulse integrity.

A recommended step in the prevention of trouble from this source is the use of low-crosstalk ribbon (available from Spectra-Strip or surplus from Optoelectronics in Florida), or better still, ribbon cable with every other line grounded. As shown in Photo 2, I used the former and have had no problems.

Plugging Chips

Questions arose during the process of making the conversion concerning the desirability of plugging in the 2708s while the socket was "hot." My intuitive response was that such behavior was an optimal way to destroy chips, so I checked with Intel. The 2708 data sheet states that power on/off sequences should follow a rigorous procedure, with V_{BB} (-5V) applied prior to V_{CC} (+5V) and V_{DD} (+12V), and with V_{BB} also the last supply shut off.

Systems Division, which routinely builds Intellec Microcomputer Development Systems with front-panel EROM programmers, ignores all that and allows unrestricted plugging and unplugging of the chips. Other programmer manufacturers seem to do the same (in fact, I could find no industrial user who followed the Intel specifications), so I concluded that the little devices are tougher than their makers suggest.

Whatever the case, the unit shown in the photographs has programmed about thirty 2708s since it arose from the bench clutter, and they all perform their function uneventfully.

Free At Last!

The modified Bytesaver brings out of the closet much of the latent usefulness in the original design. Freed from the gut-wrenching thermal cycling associated with frequent power-up/down sequences, the process of system development involving EROMs is almost pleasant.

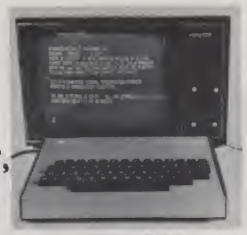
It is no longer a necessary chore to disassemble your rack-mounted processor in order to change a status bit in your I/O driver or to copy a program for an associate, and contact wear, both on the venerable S-100 bus and on the ill-suited TI sockets, is kept to a safe minimum. It might even be possible to screw on the cover and forget it for a while! ■

[1]Note: Locations in the 2708 can be changed from a 1 to a 0 by even a "normal" write cycle when program power is on. Always be sure to leave the switch OFF when not actually burning a ROM. The error can be extremely frustrating, especially with the Cromemco ZM1 monitor, which starts at FFFF and seeks downward for the first RAM into which to place its stack. The "RAM" might turn out to be the program you just placed in ROM!

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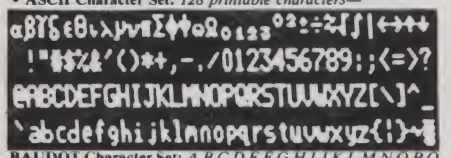
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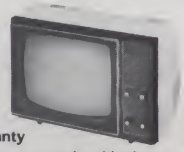
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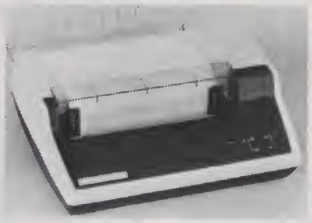
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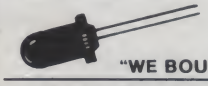
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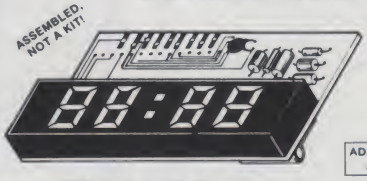
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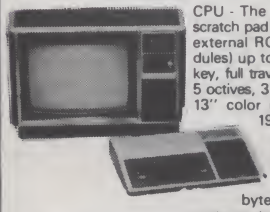
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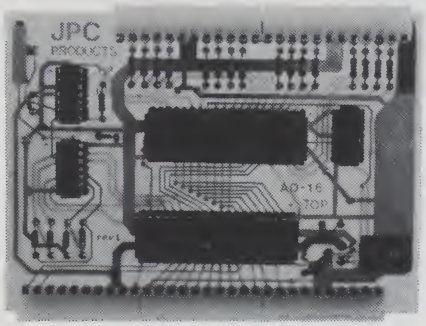
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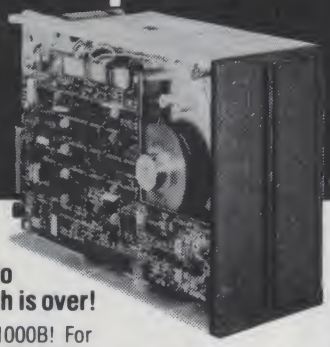
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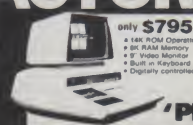
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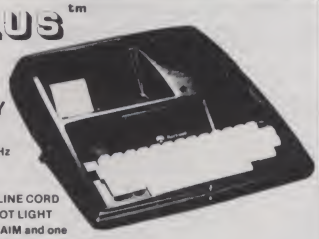
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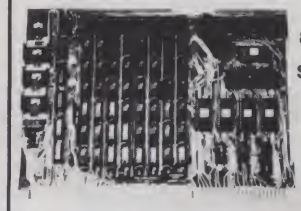
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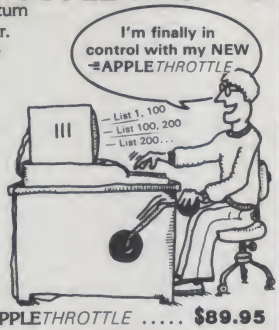
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GT-5 Moving Maze—If you don't have a lot of patience, then you had better not try this game. You must get from one side of the maze to the other side through moving gateways. A usable gateway may or may not appear soon, but when one does you had better be ready to react. Failure to react fast enough can cause you to be slammed out of existence! (Available in Level II only.) Price: $10.00

Note: Sound effects games require no extra wiring or interfacing.

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OUTPUT

(from page 8)

the five- and six-year-olds something, you'll have to make it into a game for them so they will have fun and keep going because they are enjoying it. Learning has to be fun if it is ever going to be popular.

Careers

Instant Software is still looking for people interested in a career in microcomputing. Someone with extensive experience in BASIC programming might qualify for editor-in-chief, with the responsibility for soliciting and evaluating programs. More help is required in production, purchasing, accounting, sales, advertising and writing. If we're ever going to achieve our goal of five new program packages produced per working day, we're going to need a lot more dedicated people. No smokers, please.

PET-POURRI

(from page 20)

erating systems. Its text editor features auto line numbering, search commands and renumbering capability. The $49.95 price includes a large manual with examples and a cassette ready to LOAD and RUN. Soon Moser will offer a graphics drawing compiler for use with the ASSM/TED.

Programma International

Programma International is on the move. A few months ago I told you to watch them. They now are distributors for software from PETSOFT, a major software house in England. Programma now will have more good programs to add to their already large offerings; included will be PET-FORTH, a high-level-language compiler for the PET. The best news is that Programma will distribute the final version of Mike Richter's sophisticated software package, Hunt. Hunt remains on my list of best PET programs. I'm glad that Mike has a good company distributing his final, polished version. Preliminary versions that I offered via the *PET Gazette* are now replaced by the final version. All orders and inquiries should be made to Programma. Orders for the preliminary versions will automatically, be forwarded to Programma. Other Programma programs include: Home Accounting, Math Pack, Personal Accounting System and Word Processor.

Programmer's Tool Kit

Skyles Electric Works (10301 Stonydale Dr., Cupertino CA 95014) has a ROM set that both old- and new-PET owners should be interested in. It adds these 11 commands to your PET BASIC:

- AUTO—Provides auto line numbering.
- HELP—This command will list the line in your BASIC program where an error occurred, and the erroneous portion is indicated in reverse video.
- TRACE, STEP, OFF—Let you see the sequence in which your program executes in the upper-right corner of your screen.
- FIND—Prints lines that include the string you specify.
- RENUMBER—Now you can renumber any BASIC program in your PET without having to load in a renumber program.
- APPEND—Merges program segments.
- UNLIST
- DELETE—Deletes groups of lines.
- DUMP—Lists all variables with their contents.

These commands are all available as soon as you turn on your PET. You never have to worry about loading the programs from tape. To order this ROM chip, make sure to specify how you wish to use it.

1. With the Skyles Memory Expansion system—$75.
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with your request.

Merge Programs

This merging method is by Brad Templeton. It was previously printed in "PET User Notes," 1-6. Jim Butterfield said we could relate this information.

1. Load the program you wish to merge onto another.
2. Rewind a blank cassette. Label it ASCII of program name.
3. Type in this line: OPEN1,1, 1:CMD1:LIST [RETURN].
4. Press RECORD and PLAY as requested.
5. After tape stops moving, type Example 3 for old PET and Example 4 for new PET.

You now have a tape of the program, currently in the PET, that can be merged with other programs not containing the same line numbers. It is an ASCII listing of the program. We will refer to it as ASCII Program.

Now, here is how to do the merge. You have two programs. One is ASCII Program; the other is the one you wish to add ASCII Program to. We will refer to it as Original Program.

1. Load Original Program into PET.
2. Remove tape and place ASCII Program cassette into tape #1 and rewind it.
3. Type: OPEN1 [RETURN].
4. Press PLAY as requested and wait for tape to stop moving.
5. Clear the screen and type four cursor-downs: [CLR, 4 DOWN].
6. Type Example 5 for the old PET and Example 6 for the new PET. Do not hit RETURN.
7. Type cursor home and six cursor-downs: [HOME, 6 DOWN].
8. Type the same line as listed in step 6.
9. Hit RETURN.
10. Your tape will move. Eventually, things stop with a ?SYNTAX ERROR or ?OUT OF DATA printed between the two lines. The tape should then stop moving. If not, simply hit the STOP key.
11. Type: CLOSE 1 [RETURN].
12. SAVE your now completely merged program.

Correspondence to: Len Lindsay, 1929 Northport Dr., Rm. 6, Madison WI 53704.

?"POKE611,0":PRINT#1:CLOSE1 [RETURN]

Example 3.

?"POKE175,0":PRINT#1:CLOSE1 [RETURN]

Example 4.

POKE611,1:POKE525,1:POKE527,13:?"[HOME]"

Example 5.

POKE175,1:POKE158,1:POKE623,13:?"[HOME]"

Example 6.

PRODUCTS

(from page 27)

ters on clear) that comes with each cassette. The decals are easily and permanently placed on the front surface of each key on your keyboard, which readily identifies each shorthand key function. TSHORT loads in low memory, thereby not interfering with BASIC, DOS or user machine-language routines. Price is $9.95.

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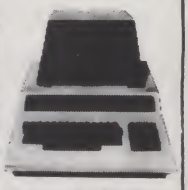
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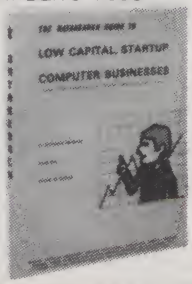
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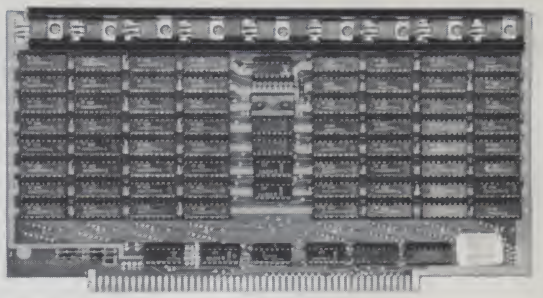
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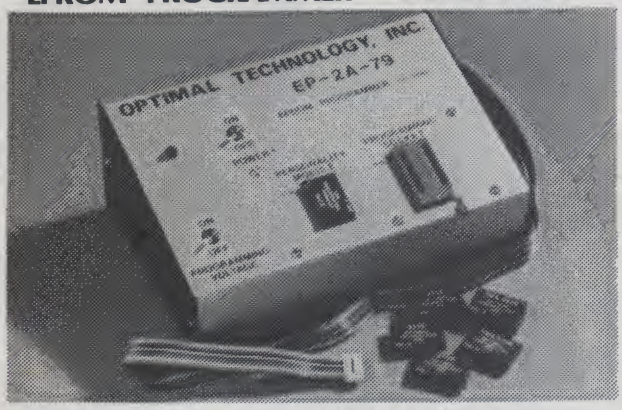


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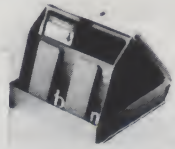
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- All S-100 BUS signals labeled and numbered
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- 4 to-220 regulator positions available
- Allows either positive or negative regulators
- Dense hole configuration

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- Double sided PC board
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- All S-100 BUS signals labeled and numbered
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- 4 to-220 regulator positions available
- Allows either positive or negative regulators
- Dense hole configuration

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Model 2501A S-100
Mother Board
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- Distributed bypassing of all power lines
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- Solder plated circuit area

Cat No. 1616 Kit $ 90.00
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Model 2520A
S-100
Extender/ Terminator
- Active and/or dynamic termination
- All power lines fused for protection
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- Can be used as an extender and/or terminator
- Solder mask both sides of board
- Silkscreened reference designations
- Gold plated fingers

Cat No. 2520 Kit $ 37.95

Model 7811A
Apple II
Arithmetic Processor
- Based on AMD AM9511 device
- Fixed point 16 and 32 bit operation
- Floating point 32 bit operation
- Binary data formats
- Add, subtract, multiply, and divide
- Trigonometric and inverse trigonometric functions
- Square roots, logarithms, exponentiation
- Float to fixed and fixed to float conversions
- Stack oriented operand storage
- Programmed I/O data transfer
- End signal selectable interrupt
- Supports interrupt daisy chain
- Allows DMA daisy chain
- Power down ROM
- 256 bytes firmware (ROM) or software (RAM) space available

Cat No. 1635 $375.00

Model 7114A
Apple II
Prom Module
The 7114A PROM MODULE permits the addition or replacement of the Apple II firmware without the physical removal of the Apple II ROMS. This allows software/firmware replacement, change, and/or patch to be made on a ROM or BYTE BASIS. An on-board enable/disable toggle switch is also available.
- BYTE oriented program overlay
- Selectable prom overlay
- Power down of PROMS
- 14K PROM space available
- Uses +5 volt 2716 type proms
- Allows use of DMA/interrupt daisy chains

Cat No. 1631 A&T $ 72.00
Cat No. 1630 Kit $ 62.00

Model 2016B
S-100
16K Static Memory
- Fully static operation
- Uses 2114 type static rams
- +8 VDC input at less than 2 amps
- Bank select available by bank port and bank byte
- Phantom line capability
- Addressable in 4K blocks in 4K increments
- 4K blocks can be located anywhere within 64K bank
- May be used as a 4K, 8K, 12K or 16K memory board
- Led indicators for board/bank active indication
- Solder mask on both sides of board
- Silk screen with part and reference designation
- Available fully assembled and tested, as a kit, or as a bare board

Cat No.1601A Kit 450ns $285.00
Cat No.1601B Kit 200ns $340.00
Cat No.1602A A&T 450ns $330.00
Cat No.1602B A&T 200ns $385.00

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Apple II
3¾ Digit BCD A/D Converter
The 7470 allows conversion of a DC voltage to a BCD number for computer monitoring and analysis. Typical inputs would be DC inputs from temperature or pressure transducers.
- Selectable interrupt on end of conversion
- 200μS per conversion
- −4 to +4 VDC full scale
- Plus or minus .05% nonlinearity
- Plus or minus 1 count quantization
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- Temperature coefficient adjustment
- Calibration adjustment
- Input offset adjustment
- Floating inputs
- Overange and sign indicators
- Input filter
- Power down ROM
- Supports interrupt daisy chain
- Allows DMA daisy chain
- 256 byte firmware (ROM) or software (RAM) space available

Cat No. 1621 Kit $115.00
Cat No. 1622 A&T $135.00

Model 2200A
Mainframe
- S-100 compatible
- Industrial/commercial quality construction
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- Excellent cooling capability
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- Input 105, 115, or 125 VAC
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- All parts available separately

Cat No. 1612 Kit $330.00
Cat No. 1614 A&T $375.00

Model 7440A
Apple II
Programmable Timer Module
- Flexible external interface patch area for custom interface applications
- Selectable prescaler on timer 3 capable of 4mhz input
- Programmable interrupts
- Readable down counter indicates counts to go to time-out
- Selectable gating for frequency or pulse width comparison
- Three asynchronous external clock and gate/trigger inputs internally synchronized
- Three maskable outputs to patch area
- Power down ROM
- Supports interrupt daisy chain
- Allows DMA daisy chain
- 256 byte firmware (ROM) or software (RAM) space available

Cat No. 1617 Kit $135.00
Cat No. 1618 A&T $145.00

Apple II
Model 7712A
Synchronous Serial Interface
- Conforms to RS-232C (configuration A thru E)
- Supports half or full duplex operation
- DTE type configuration
- Failsafe RS-232C operation
- 14 STD CLK rates 50-19.2K BAUD plus EXT CLK
- BAUD rates dip switch selectable
- All BAUD rates crystal controlled
- Programmable interrupts from transmitter, receiver, and error detection logic
- Character SYNC by one or two SYNC codes
- Programmable SYNC code register
- Standard synchronous signaling rate per RS-269/ANSI X3.1-1976
- Peripheral/modem control functions
- Three bytes of fifo buffering on both transmit and receive date
- 7,8, or 9 bit transmission
- Optional odd, even, or no parity bit
- Parity, overrun, and overflow status checks
- Power down prom
- 256 bytes firmware (ROM) or software (RAM) space available
- Supports interrupt daisy chain
- Allows DMA daisy chain

Cat No. 1627 Kit $ 90.00

Apple II
Model 7710A
Asynchronous Serial Interface
- Parity, overrun, and framing error check
- Optional divide by 16 clock mode
- False start bit detection
- Software programmable interrupts
- Data double buffered
- One or two stop bit operation
- Power down PROM
- 256 bytes firmware (ROM) or software (RAM) space available
- Supports interrupt daisy chain
- Allows DMA daisy chain
- 134.5 BAUD available for selectric interface
- Conforms to RS-232C (configuration A thru E)
- Supports half or full duplex operation
- DCR type interface
- Failsafe RS-232C operation
- 14 STD CLK rates 50-19.2K BAUD plus EXT CLK
- BAUD rates dip switch selectable
- All BAUD rates crystal controlled except EXT
- 8 and 9 bit transmission
- Optional even, odd, and no parity bit
- Programmable control register

Cat No. 1624 A&T $145.00
Cat No. 1623 Kit $ 90.00

Model 7720A
Apple II
Parallel Interface
- Two bi-directional 8 bit buses for interface to peripherals
- Tow programmable control registers
- Two programmable data direction registers
- Four individually controlled interrupt input lines; two useable as peripheral control outputs
- Handshake control logic for input and output peripheral operation
- High impedance 3 state and direct transistor drive pheripheral lines
- Programmable interrupts
- CMOS drive capability on side A peripheral lines
- 2 TTL drive capability on all A and B side buffers
- Power down ROM
- Supports interrupt daisy chain
- Allows DMA daisy chain
- 256 bytes firmware (ROM) or software (RAM) space available

Cat No. 1633 A&T $105.00
Cat No. 1632 Kit $ 62.00

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Wire Wrap Board
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- Perimeter ground
- Size: 7 inch long x 2.75 inch high
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1826 80 column dot matrix tractor feed printer $965
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1713	PET Graphics	14.95
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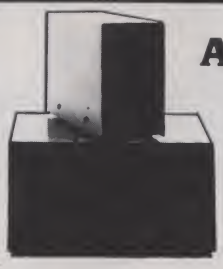
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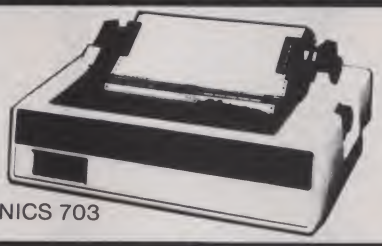
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Super Basic on Cassette **$40.00**

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16K Dynamic RAM board expandable to 32K for less than **$150.**

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier *and Speaker;* Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00**, on ROM **$38.00**, original Elf kit board **$14.95.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. A Godbout 8K RAM board is available for $135.00. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

The **Power Supply Kit** for the Super Expansion Board is a 5 amp supply with multiple positive and negative voltages $29.95. Add $4.00 for shipping. Prepunched frame $7.50. Case $10.00. Add $1.50 for shipping.

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7422N	1.39	LM320T-8	1.60	CD4022	86
7430N	20	LM320T-12	1.50	CD4023	28
7442N	50	LM320T-15	1.60	CD4024	75
7445N	89	LM324N	1.15	CD4025	28
7447N	60	LM339N	1.55	CD4028	1.51
7448N	69	LM340K-5	1.35	CD4027	36
7450N	17	LM340K-8	1.35	CD4028	79
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7490N	43	LM340T-8	1.25	CD4042	71
7492N	43	LM340T-12	1.25	CD4043	83
7493N	43	LM340T-15	1.25	CD4044	63
7495N	69	LM340T-18	1.25	CD4048	1.67
74100N	90	LM340T-24	1.25	CD4049	36
74107N	29	LM343H	4.50	CD4050	36
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74161N	87	LM709H	28	CD4073	28
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74163N	87	LM733N	.67	CD4076	1.75
74174N	96	LM741CH	35	CD4078	40
74175N	90	LM741N	.25	CD4081	28
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Digital Temp. Meter Kit $39.95

Indoor and outdoor. Switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Beautiful woodgrain case w/bezel **$11.75**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
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FREE: Send for your copy of our NEW 1979 QUEST CATALOG. Include 28¢ stamp.

✓ *Reader Service—see page 227*

AIM 65 BY ROCKWELL INTERNATIONAL



AIM 65 is fully assembled, tested and warranted. With the addition of a low cost, readily available power supply, it's ready to start working for you.

AIM 65 features on-board thermal printer and alphanumeric display, and a terminal-style keyboard. It has an addressing capability up to 65K bytes, and comes with a user-dedicated 1K or 4K RAM. Two installed 4K ROMS hold a powerful Advanced Interface Monitor program, and three spare sockets are included to expand on-board ROM or PROM up to 20K bytes.

An Application Connector provides for attaching a TTY and one or two audio cassette recorders, and gives external access to the user-dedicated general purpose I/O lines.

Also included as standard are a comprehensive AIM 65 User's Manual, a handy pocket reference card, an R6500 Hardware Manual, an R6500 Programming Manual and an AIM 65 schematic.

AIM 65 is packaged on two compact modules. The circuit module is 12 inches wide and 10 inches long, the keyboard module is 12 inches wide and 4 inches long. They are connected by a detachable cable.

THERMAL PRINTER
Most desired feature on low-cost microcomputer systems . . .
- Wide 20-column printout
- Versatile 5 x 7 dot matrix format
- Complete 64-character ASCII alphanumeric format
- Fast 120 lines per minute
- Quite thermal operation
- Proven reliability

FULL-SIZE ALPHANUMERIC KEYBOARD
Provides compatibility with system terminals . . .
- Standard 54 key, terminal-style layout
- 26 alphabetic characters
- 10 numeric characters
- 22 special characters
- 9 control functions
- 3 user-defined functions

TRUE ALPHANUMERIC DISPLAY
Provides legible and lengthy display . . .
- 20 characters wide
- 16-segment characters
- High contrast monolithic characters
- Complete 64-character ASCII alphanumeric format

PROVEN R6500 MICROCOMPUTER SYSTEM DEVICES
Reliable, high performance NMOS technology . . .
- R6502 Central Processing Unit (CPU), operating at 1 MHz. Has 65K address capability, 13 addressing modes and true index capability. Simple but powerful 56 instructions.
- Read/Write Memory, using R2114 Static RAM devices. Available in 1K byte and 4K byte versions.
- 8K Monitor Program Memory, using R2332 Static ROM devices. Has sockets to accept additional 2332 ROM or 2532 PROM devices, to expand on-board Program memory up to 20K bytes.
- R6532 RAM-Input/Output-Timer (RIOT) combination device. Multipurpose circuit for AIM 65 Monitor functions.
- Two R6522 Versatile Interface Adapter (VIA) devices, which support AIM 65 and user functions. Each VIA has two parallel and one serial 8-bit, bidirectional I/O ports, two 2-bit peripheral handshake control lines and two fully-programmable 16-bit interval timer/event counters.

BUILT-IN EXPANSION CAPABILITY
- 44-Pin Application Connector for peripheral add-ons
- 44-Pin Expansion Connector has full system bus
- Both connectors are KIM-1 compatible

TTY AND AUDIO CASSETTE INTERFACES
Standard interface to low-cost peripherals . . .
- 20 ma. current loop TTY interface
- Interface for two audio cassette recorders
- Two audio cassette formats: ASCII KIM-1 compatible and binary, blocked file assembler compatible

ROM RESIDENT ADVANCED INTERACTIVE MONITOR
Advanced features found only on larger systems . . .
- Monitor-generated prompts
- Single keystroke commands
- Address independent data entry
- Debug aids
- Error messages
- Option and user interface linkage

ADVANCED INTERACTIVE MONITOR COMMANDS
- Major Function Entry
- Instruction Entry and Disassembly
- Display/Alter Registers and Memory
- Manipulate Breakpoints
- Control Instruction/Trace
- Control Peripheral Devices
- Call User-Defined Functions
- Comprehensive Text Editor

LOW COST PLUG-IN ROM OPTIONS
- 4K Assembler—symbolic, two-pass
- 8K BASIC Interpreter

POWER SUPPLY SPECIFICATIONS
- +5 VDC ± 5% regulated @ 2.0 amps (max)
- +24 VDC ± 15% unregulated @ 2.5 amps (peak) 0.5 amps average

PRICE: $375.00 (1K RAM)

Plus $4.00 UPS (shipped in U.S. must give **street** address), $10 parcel post to APO's, FPO's, Alaska, Hawaii, Canada, $25 air mail to all other countries

We manufacture a complete line of high quality expansion boards. Use reader service card to be added to our mailing list, or U.S. residents send $1.00 (International send $3.00 U.S.) for airmail delivery of our complete catalog.

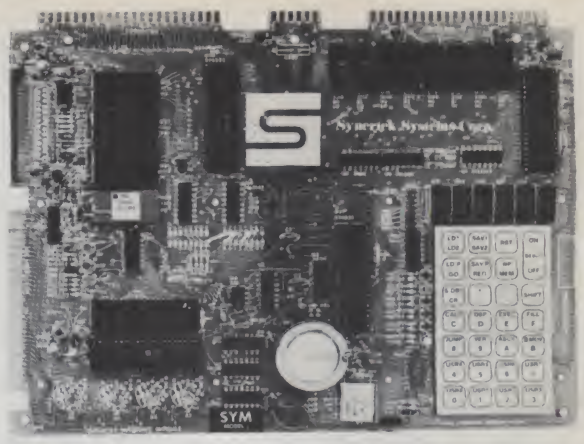
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SYM-1, 6502-BASED MICROCOMPUTER

- FULLY-ASSEMBLED AND COMPLETELY INTEGRATED SYSTEM that's ready-to-use
- ALL LSI IC'S ARE IN SOCKETS
- 28 DOUBLE-FUNCTION KEYPAD INCLUDING UP TO 24 "SPECIAL" FUNCTIONS
- EASY-TO-VIEW 6-DIGIT HEX LED DISPLAY
- KIM-1* HARDWARE COMPATIBILITY
  The powerful 6502 8-Bit MICROPROCESSOR whose advanced architectural features have made it one of the largest selling "micros" on the market today.
- THREE ON-BOARD PROGRAMMABLE INTERVAL TIMERS available to the user, expandable to five on-board.
- 4K BYTE ROM RESIDENT MONITOR and Operating Programs.
- Single 5 Volt power supply is all that is required.
- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes.
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
- ENHANCED SOFTWARE with simplified user interface
- STANDARD INTERFACES INCLUDE:
  —Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 1500 Baud)
  —Full duplex 20mA Teletype Interface
  —System Expansion Bus Interface
  —TV Controller Board Interface
  —CRT Compatible Interface (RS-232)
- APPLICATION PORT: 15 Bi-directional TTL Lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD



Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately.

SYM-1 Complete w/manuals **$249.00**
SYM-1 User Manual Only **7.00**
SYM-1 Expansion **75.00**
Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand.

SYM-1 CAN GROW AS YOU GROW. It's the system to BUILD-ON.

Expansion features that are available:

BAS-1 8K Basic ROM (Microsoft Basic) **129.00**
Kim-2 (Complete terminal less monitor) **349.00**

QUALITY EXPANSION BOARDS DESIGNED SPECIFICALLY FOR KIM-1, SYM-1 & AIM 65

These boards are set up for use with a regulated power supply such as the one below, but, provisions have been made so that you can add onboard regulators for use with an unregulated power supply. But, because of unreliability, we do not recommend the use of onboard regulators. All I.C.'s are socketed for ease of maintenance. *All boards carry full 90-day warranty.*

All products that we manufacture are designed to meet or exceed industrial standards. All components are first qualtiy and meet full manufacturer's specifications. All this and an extended burn-in is done to reduce the normal percentage of field failures by up to 75%. To you, this means the chance of inconvenience and lost time due to a failure is very rare; but, if it should happen, we guarantee a turn-around time of less than forty-eight hours for repair.

Our money back guarantee: If, for any reason you wish to return any board that you have purchased directly from us within ten (10) days after receipt, complete, in original condition, and in original shipping carton; we will give you a complete credit or refund less a $10.00 restocking charge per board.

VAK-1 8-SLOT MOTHERBOARD

This motherboard uses the KIM-4* bus structure. It provides eight (8) expansion board sockets with rigid card cage. Separate jacks for audio cassette, TTY and power supply are provided. Fully buffered bus.

VAK-1 Motherboard **$129.00**

VAK-2/4 16K STATIC RAM BOARD

This board using 2114 RAMs is configured in two (2) separately addressable 8K blocks with individual write-protect switches.

VAK-2 16K RAM Board with only 8K of RAM (½ populated) **$239.00**
VAK-3 Complete set of chips to expand above board to 16K **$175.00**
VAK-4 Fully populated 16K RAM **$379.00**

VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and ±12 VDC, but has a DC to DC multiplyer so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer **$269.00**

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. *EPROMs not included.*

VAK-6 EPROM Board **$129.00**

VAK-7 COMPLETE FLOPPY-DISK SYSTEM (May '79)

VAK-8 PROTYPING BOARD

This board allows you to create your own interfaces to plug into the motherboard. Etched circuitry is provided for regulators, address and data bus drivers; with a large area for either wire-wrapped or soldered IC circuitry.

VAK-8 Protyping Board **$49.00**

POWER SUPPLIES

ALL POWER SUPPLIES are totally enclosed with grounded enclosures for safety, AC power cord, and carry a full 2-year warranty.

FULL SYSTEM POWER SUPPLY

This power supply will handle a microcomputer and up to 65K of our VAK-4 RAM. ADDITIONAL FEATURES ARE: Over voltage Protection on 5 volts, fused, AC on/off switch. Equivalent to units selling for $225.00 or more.

Provides +5 VDC @ 10 Amps & ±12 VDC @ 1 Amp
VAK-EPS Power Supply **$125.00**

KIM-1* Custom P.S. provides 5 VDC @ 1.2 Amps and +12 VDC @ .1 Amps
KCP-1 Power Supply **$41.50**

SYM-1 Custom P.S. provides 5 VDC @ 1.4 Amps
VCP-1 Power Supply **$41.50**

*KIM is a product of MOS Technology

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DIODES/ZENERS

QTY.			
1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zenner	.25
1N4749	24v	1W	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25
1N5349	12v	3W	.25

SOCKETS/BRIDGES

QTY.				
8-pin	pcb	.16	ww	.35
14-pin	pcb	.20	ww	.40
16-pin	pcb	.25	ww	.45
18-pin	pcb	.30	ww	.95
20-pin	pcb	.35	ww	1.05
22-pin	pcb	.40	ww	1.15
24-pin	pcb	.45	ww	1.25
28-pin	pcb	.50	ww	1.35
40-pin	pcb	.55	ww	1.45
Molex pins .01	To-3 Sockets			.35
2 Amp Bridge	100-prv			.95
25 Amp Bridge	200-prv			1.50

TRANSISTORS, LEDS, etc.

QTY.		
2N2222M	(2N2222 Plastic .10)	.15
2N2222A		.19
2N2907A	PNP	.19
2N3906	PNP (Plastic)	.19
2N3904	NPN (Plastic)	.19
2N3054	NPN	.55
2N3055	NPN 15A 60v	.60
T1P125	PNP Darlington	1.95
LED Green,	Red, Clear, Yellow	.19
D.L.747	7 seg 5/8" High com-anode	1.95
MAN72	7 seg com-anode (Red)	1.25
MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74	7 seg com-cathode (Red)	1.50
FND359	7 seg com-cathode (Red)	1.25

9000 SERIES

QTY.		QTY.	
9301	.85	9322	.65
9309	.50	9601	.30
9316	1.25	9602	.45

MICRO's, RAMS, CPU's, E-PROMS

QTY.	
8T13	2.50
8T23	2.50
8T24	3.00
8T97	1.75
74S188	3.00
1488	1.25
1489	1.25
1702A	6.50
AM 9050	5.00
ICM 7207	6.95
ICM 7208	13.95
MPS 6520	10.00
MM 5314	4.00
MM 5316	4.50
MM 5387	3.50
MM 5369	2.95
TR 1602B	3.95
UPD 414	4.95
Z 80 A	19.50
Z 80	14.50
Z 80 P10	10.50
2102	1.45
2102L	1.75
2107B-4	4.95
2114	9.50
2513 Upper or Lower	7.25
2708	12.50
2716 D.S.	29.00
2716 (5v)	69.00
2758 (5v)	32.95
3242	10.50
4116	13.50
6800	13.95
6850	7.95
8080	9.50
8085	22.50
8212	3.75
8214	4.95
8216	4.50
8224	5.25
8228	6.00
8251	8.50
8253	18.50
8255	9.50
TMS 4044	10.95

C MOS

QTY.		QTY.		QTY.		QTY.	
4000	.20	4018	.75	4037	1.80	4071	.25
4001	.30	4019	.35	4040	.75	4072	.60
4002	.25	4020	.85	4041	.69	4081	.30
4004	3.95	4021	.75	4042	.65	4082	.30
4006	1.50	4022	.75	4043	.50	4507	.95
4007	.25	4023	.25	4044	.65	4511	.95
4008	.75	4024	.75	4046	1.25	4512	1.25
4009	.35	4025	.25	4047	2.50	4515	2.95
4010	.35	4026	1.95	4048	1.75	4519	.85
4011	.35	4027	.35	4049	.65	4522	1.10
4012	.25	4028	.75	4050	.45	4526	.95
4013	.40	4029	1.15	4052	.75	4528	1.10
4014	.75	4030	.30	4053	.95	4529	.95
4015	.75	4033	1.50	4066	.75	MC14409	14.50
4016	.35	4034	2.45	4069/74C04	.45	MC14419	4.85
4017	.75	4035	.75	4070	1.00	74C151	2.50

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QTY.		QTY.		QTY.		QTY.	
7400	.20	7492	.45	74H10	.35	74LS51	.75
7401	.20	7493	.35	74H11	.25	74LS74	1.50
7402	.20	7494	.75	74H15	.45	74LS75	1.20
7403	.20	7495	.60	74H20	.25	74LS76	.70
7404	.45	7496	.80	74H21	.25	74LS86	.95
7405	.35	74100	1.15	74H22	.40	74LS90	.85
7406	.35	74107	.35	74H30	.30	74LS93	.85
7407	.55	74121	.45	74H40	.35	74LS96	2.00
7408	.40	74122	.55	74H50	.30	74LS107	.90
7409	.25	74123	.55	74H51	.30	74LS109	1.50
7410	.20	74125	.45	74H52	.20	74LS123	1.95
7411	.25	74126	.45	74H53	.25	74LS138	2.00
7412	.25	74132	.75	74H55	.25	74LS151	.95
7413	.45	74141	.90	74H72	.35	74LS153	1.15
7414	.95	74145	1.35	74H74	.35	74LS157	1.15
7416	.25	74150	.85	74H101	.95	74LS160	1.15
7417	.40	74151	1.15	74H103	.55	74LS164	2.90
7420	.25	74153	1.15	74H106	1.15	74LS193	2.00
7426	.25	74154	1.15	74L00	.30	74LS195	1.15
7427	.25	74156	.70	74L02	.30	74LS244	2.90
7430	.20	74157	.65	74L03	.35	74LS259	1.50
7432	.50	74161	.95	74L04	.40	74LS298	1.50
7437	.20	74163	.85	74L10	.30	74LS367	2.50
7438	.30	74164	.75	74L20	.45	74LS368	1.25
7440	.20	74165	1.10	74L30	.55	74LS373	2.50
7441	1.15	74166	2.25	74L47	1.95	74S00	.60
7442	.55	74175	.90	74L51	.65	74S02	.45
7443	.45	74176	.95	74L55	.85	74S03	.35
7444	.45	74177	1.10	74L72	.65	74S04	.65
7445	.75	74180	.95	74L73	.70	74S05	.45
7446	.70	74181	2.25	74L74	.75	74S08	.65
7447	.70	74182	.75	74L75	1.05	74S10	.45
7448	.50	74190	1.25	74L85	2.00	74S11	.45
7450	.25	74191	1.25	74L93	.75	74S20	.35
7451	.25	74192	.75	74L123	1.95	74S22	.55
7453	.20	74193	.85	74LS00	.60	74S40	.30
7454	.25	74194	.95	74LS01	.40	74S50	.30
7460	.40	74195	.95	74LS02	.55	74S51	.35
7470	.45	74196	.95	74LS03	.45	74S64	.15
7472	.40	74197	.95	74LS04	.65	74S74	1.50
7473	.25	74198	1.45	74LS05	.45	74S112	.60
7474	.50	74221	2.25	74LS08	.65	74S114	.85
7475	.35	74298	1.50	74LS09	.45	74S133	.85
7476	.40	74367	1.35	74LS10	.45	74S140	.75
7485	.75	75451	.65	74LS11	.45	74S151	.95
7481	.85	75452	.65	74LS20	.45	74S153	.95
7482	.95	75491	.65	74LS21	.45	74S157	.98
7483	.95	75492	.65	74LS22	.45	74S158	.80
7485	.75	74H00	.20	74LS32	.60	74S194	2.25
7486	.55	74H01	.30	74LS37	.45	74S196	2.00
7489	1.05	74H04	.30	74LS38	.45	74S257 (8123)	2.95
7490	.55	74H05	.25	74LS40	.70	8131	2.75
7491	.70	74H08	.35	74LS42	1.25		

I^2L, LINEARS, REGULATORS, ETC.

QTY.		QTY.		QTY.	
MCT2	.95	LM320K24	1.65	LM373	3.95
8038	3.95	LM320T5(7905)	1.65	LM377	3.95
LM201	.75	LM320T12	1.65	78L05	.75
LM301	.45	LM320T15	1.65	78L12	.75
LM308	.65	LM323K	5.95	78L15	.75
LM309H	.85	LM324	1.25	78M05	.75
LM309 (340K-5)	1.50	LM339	.75	LM380 (8-14 Pin)	1.19
LM310	.85	7805 (340T5)	1.15	LM709 (8-14 Pin)	.45
LM311 (8-14 Pin)	.75	LM340T12	.95	LM711	.45
LM318	1.50	LM340T15	.95	LM723	.40
LM320H6	.79	LM340T18	.95	LM725	3.50
LM320H15	.79	LM340T24	.95	LM739	1.50
LM320H24	.79	LM340K12	1.25	LM741 (8-14)	.45
LM320K5	1.65	LM340K15	1.25	LM747	1.10
LM320K12	1.65	LM340K18	1.25	LM1307	1.75
LM320K15	1.65	LM340K24	1.25	LM1458	.65
				LM3900	1.50
				NE555	.45
				NE556	.85
				NE565	1.15
				NE566	1.25
				NE567	.95
				TA7205	4.95
				76477	2.95
				95H90	9.95

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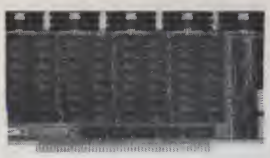
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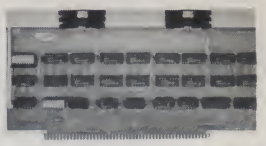
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Total Order	Deduct
$35-$99	10%
$100-$300	15%
$301-$1000	20%

We Specialize in High Technology at Low Prices.



Econoram* boards are generally available in 3 forms: **unkit** (sockets and bypass caps are **pre-soldered** in place for simple, one-evening assembly), **assembled and tested**, or qualified under our high-reliability **Certified System Component (CSC)** program (200 hour burn-in, immediate replacement in event of failure within 1 year of invoice date). 1 year limited warranty on all products. Refer to chart below for pricing.



Name	Storage	Buss	Configurations	Notes	Unkit	Assm	CSC
Econoram IIA	8K X 8	S-100	2-4K blocks	1	**$149**	**$179**	**$239**
Econroam IV	16K X 8	S-100	1-16K	1	**$269**	**$329**	**$429**
Econoram VIIA-16	16K X 8	S-100	2-4K, 1-8K	1	**$279**	**$339**	**$439**
Econoram VIIA-24	24K X 8	S-100	2-4K, 2-8K	1	**$398**	**$485**	**$605**
Econoram IX-16	16K X 8	Dig Grp	2-4K, 1-8K	1	**$319**	**$379**	n/a
Econoram IX-32	32K X 8	Dig Grp	2-4K, 1-8K, 1-16K	1	**$559**	**$639**	n/a
Econoram X	32K X 8	S-100	2-8K, 1-16K	1	**$529**	**$649**	**$789**
Econoram XI	32K X 8	SBC/BLC	2-8K, 1-16K	1	n/a	n/a	**$1050**
Econoram XII-16	16K X 8	S-100	see notes	1, 2	**$329**	**$419**	**$519**
Econoram XII-24	24K X 8	S-100	see notes	1, 2	**$429**	**$539**	**$649**
Econoram XIII	32K X 8	S-100	see notes	1, 3	**$559**	**$699**	**$849**
Econoram XIV	16K X 8	S-100	see notes	1, 4, 5	**$289**	**$349**	**$449**
Econoram XV-16	16K X 8	H8	1-16K	1, 6	**$329**	**$395**	n/a
Econoram XV-32	32K X 8	H8	2-16K	1, 6	**$599**	**$729**	n/a

Notes:
1. Works at 5 MHz with 8085 or at 4 MHz with Z-80.
2. Bank select board — 2 independent banks addressable on 8K boundaries.
3. Bank select board — 2 independent banks addressable on 16K boundaries.
4. Bank select board — 1 bank addressable on 4K boundaries.
5. 24 address lines for extended addressing.
6. Bank select option for implementing memory systems greater than 64K.

*Econoram is a trademark of Bill Godbout Electronics.

Coming soon: This month, we're announcing the **Econoram XIV** with extended addressing, two new **Econorams (XV-16 and XV-32)** for the H8 buss, and our **Memory Management Board.** In the next few months, we'll be introducing...

- 4 MHz Z-80 CPU board
- 5 MHz 8085 CPU board
- Triple Parallel + Single Serial board, with 3 full duplex parallel ports and serial port with full RS-232 handshake
- 12 and 18 slot motherboards — double sided, shielded, and actively terminated
- And, a rack mount or desk top enclosure, with power supply, to hold all this neat stuff

Just thought you ought to know.

16K Memory Expansion Chip Set $87.20 (regular $109; 20% off while they last)

This Godbout quality product expands memory in **Radio Shack-80, Apple,** and **Exidy Sorcerer** computers. Our chip set features low power, high speed (250 ns) parts that work with 4 MHz systems. DIP shunts included. Easy-to-follow instructions for Radio Shack-80 modification make conversion simple. 1 year limited warranty.

"INTERFACER" S-100 I/O Bd $189 unkit, $249 assm

Dual serial port with 2 full duplex parallel ports for RS-232 handshake; EIA232C line drivers and receivers (1488, 1489) along with current loop (20 mA) and TTL signals on both ports. Onboard crystal-controlled timebase with independently selectable Baud rate generators for each part (up to 19.2 KBaud). This board has hardware LSI UARTs that don't tie up the computer's CPU, operates with 2 to 5 MHz systems, includes software programmable UART parameters/interrupt enables/handshaking lines, offers provision for custom frequency compensation on both receive and transmit sides to accommodate varying speed/noise situations or unusual cable lengths...and even all this isn't the full story on what this no-excuses board can do for you.

Econoram II Closeout $129 unkit (3/$375), $155 assm

This is a limited quantity item. Our brand new **Econoram IIA** is out, but even by today's standards the original **Econoram II** is an excellent memory. 2 MHz operation, low power, configured as two independent 4K blocks, and one of the best track records in the industry for reliability and cost-effective operation. Easy one-evening assembly, 1 year limited warranty on all components.

18 Slot Motherbd Closeout — was $124, now only $109

Includes on-board active termination, with all 18 edge connectors pre-soldered in place for easy assembly. Limited quantity.

Memory Management $59 kit, $85 assm, $100 CSC

Now you can add bank select and extended addressing to older S-100 machines like the **IMSAI, Altair, Sol, Polymorphic,** etc. Either use this board with our new extended addressing boards, or retrofit our high density **Econorams** (the ones with phantom or extra qualifier lines) for use with the **Memory Management Board** to get more than 64K of memory space for your computer.

2708 EROM board unkit $85

4 independently addressable 4K blocks, with selective disable for each block. Built to **CompuPro/Econoram** standards (dipswitch addressing, top quality board, sockets wave-soldered in place), and includes dipswitch selectable jump start built right into the board. Includes all support chips and manual, but does not include EROMs.

ACTIVE TERMINATOR kit $34.50

Our much imitated design plugs into any S-100 motherboard to reduce ringing, noise, crosstalk, and other buss-related problems. This is a simple, effective, low cost way to upgrade your machine.

SEE COMPUPRO™ AT A STORE NEAR YOU.

Many Godbout computer products are available under the CompuPro name at leading computer stores world-wide. Want to see for yourself exactly what kind of quality and effort we put into turning out cost-effective, high performance boards? Then see our products in person at a computer store near you.

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at **(415) 562-0636.** COD OK with street address for UPS. Prices good through cover month of magazine.

CompuPro™ from GODBOUT ELECTRONICS

Bldg. 725, Oakland Airport, CA 94614

✓G4

FREE FLYER: We'll be glad to tell you more than the space of this ad permits. Just send your name and address, we'll take care of the rest. If you're in a hurry, enclose 41¢ in stamps for 1st class delivery.

✓ Reader Service—see page 227

7400 TTL

		SN7470N	.29		
		SN7472N	.29		
SN7400N	.16	SN7473N	.35	SN74160N	.89
SN7401N	.18	SN7474N	.35	SN74161N	.89
SN7402N	.18	SN7475N	.49	SN74162N	1.95
SN7403N	.18	SN7476N	.35	SN74163N	.89
SN7404N	.18	SN7479N	5.00	SN74164N	.89
SN7405N	.20	SN7480N	.50	SN74165N	.89
SN7406N	.29	SN7482N	.99	SN74166N	1.25
SN7407N	.29	SN7483N	.59	SN74167N	1.95
SN7408N	.20	SN7485N	.79	SN74170N	1.59
SN7409N	.20	SN7486N	.35	SN74172N	6.00
SN7410N	.18	SN7489N	1.75	SN74173N	1.25
SN7411N	.25	SN7490N	45	SN74174N	.89
SN7412N	.25	SN7491N	.59	SN74175N	.79
SN7413N	.40	SN7492N	.43	SN74176N	.79
SN7414N	.70	SN7493N	.43	SN74177N	.79
SN7416N	.25	SN7494N	.65	SN74179N	1.95
SN7417N	.25	SN7495N	.65	SN74180N	.79
SN7420N	.20	SN7496N	.65	SN74181N	1.95
SN7421N	.29	SN7497N	3.00	SN74182N	.79
SN7422N	.39	SN74100N	.89	SN74184N	1.95
SN7423N	.25	SN74107N	.35	SN74185N	1.95
SN7425N	.29	SN74109N	.59	SN74186N	9.95
SN7426N	.29	SN74116N	1.95	SN74188N	3.95
SN7427N	.25	SN74121N	.35	SN74190N	1.25
SN7429N	.39	SN74122N	.39	SN74191N	1.25
SN7430N	.20	SN74123N	.49	SN74192N	79
SN7432N	.25	SN74125N	.49	SN74193N	.79
SN7437N	.25	SN74126N	.49	SN74194N	.89
SN7438N	.25	SN74132N	.75	SN74195N	.69
SN7439N	.25	SN74136N	.75	SN74196N	.89
SN7440N	.20	SN74141N	.79	SN74197N	.89
SN7441N	.89	SN74142N	2.95	SN74198N	1.49
SN7442N	49	SN74143N	2.95	SN74199N	1.49
SN7443N	75	SN74144N	2.95	SN74S200	4.95
SN7444N	.75	SN74145N	.79	SN74251N	1.79
SN7445N	.75	SN74147N	1.95	SN74279N	.79
SN7446N	.69	SN74148N	1.29	SN74283N	2.25
SN7447N	.59	SN74150N	.89	SN74284N	3.95
SN7448N	.79	SN74151N	.59	SN74285N	3.95
SN7450N	.20	SN74152N	.59	SN74365N	.69
SN7451N	.20	SN74153N	59	SN74366N	.69
SN7453N	.20	SN74154N	.99	SN74367N	.69
SN7454N	.20	SN74155N	.79	SN74368N	.69
SN7459A	.25	SN74156N	79	SN74390N	1.95
SN7460N	.20	SN74157N	.65	SN74393N	1.95

C/MOS

CD4000	.23			CD4070	.55
CD4001	.23			CD4071	.23
CD4002	.23	CD4028	.89	CD4072	.49
CD4006	1.19	CD4029	1.19	CD4076	1.39
CD4007	.25	CD4030	.49	CD4081	23
CD4009	.49	CD4035	.99	CD4082	.23
CD4010	.49	CD4040	1.19	CD4093	.99
CD4011	.23	CD4041	1 25	CD4098	2.49
CD4012	.25	CD4042	99	MC14409	14.95
CD4013	.39	CD4043	89	MC14410	14.95
CD4014	1.39	CD4044	89	MC14411	14 95
CD4015	1.19	CD4046	1.79	MC14419	4.95
CD4018	.49	CD4047	2.50	MC14433	19.95
CD4017	1.19	CD4048	1.35	MC14506	.75
CD4018	99	CD4049	49	MC14507	99
CD4019	49	CD4050	.49	MC14562	14.50
CD4020	1.19	CD4051	1.19	MC14583	3.50
CD4021	1.39	CD4053	1.19	CD4508	3.95
CD4022	1.19	CD4056	2.95	CD4510	1.39
CD4023	.23	CD4059	9 95	CD4511	1.29
CD4024	.79	CD4060	1.49	CD4515	2.95
CD4025	.23	CD4066	.79	CD4518	1.29
CD4026	2.25	CD4068	.39	CD4520	1.29
CD4027	69	CD4069	45	CD4566	2 25

74C00

74C00	.39			74C163	2.49
74C02	.39			74C164	2.49
74C04	.39	74C85	2.49	74C173	2.60
74C08	49	74C90	1.95	74C192	2.49
74C10	.39	74C93	1.95	74C193	2.49
74C14	1.95	74C95	1.95	74C195	2.49
74C20	.39	74C107	1.25	74C922	5.95
74C30	.39	74C151	2 90	74C923	6.25
74C42	1.95	74C154	3.00	74C925	8.95
74C48	2.49	74C157	2.15	74C926	8.95
74C73	89	74C160	2 49	80C95	1.50
74C74	89	74C161	2 49	80C97	1 50

LINEAR

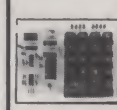
78MG	1.75			LM710N	.79
LM106H	99			LM711N	.39
LM300H	.80	LM340K-18	1.35	LM723N/H	.55
LM301CN/H	.35	LM340K-24	1.35	LM733N	1.00
LM302H	.75	LM340T-5	1.25	LM739N	1.19
LM304H	1.00	LM340T-6	1.25	LM741CN/H	.35
LM305H	.60	LM340T-8	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-12	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-15	1.25	LM748N/H	.39
LM309H	1.10	LM340T-18	1.25	LM1310N	2.95
LM309K	1.25	LM340T-24	1.25	LM1458CN/H	.59
LM310CN	1.15	LM358N	1.00	MC1488N	1.39
LM311N/H	.90	LM370N	1.95	MC1489N	1.39
LM312H	1.95	LM373N	3 25	LM1496N	.95
LM317K	6.50	LM377N	4 00	LM1556V	1.75
LM318CN/H	1.50	LM380N	1.25	MC1741SCP	3.00
LM319N	1.30	LM380CN	.99	LM2111N	1.95
LM320K-5	1.35	LM381N	1.79	LM2901N	2.95
LM320K-5.2	1.35	LM382N	1.79	LM3053N	1.50
LM320K-12	1.35	NE501N	8.00	LM3065N	1.49
LM320K-15	1.35	NE510A	6.00	LM3900N(3401)	.49
LM320K-18	1.35	NE529A	4.95	LM3905N	.89
LM320K-24	1.35	NE531H/V	3.95	LM3909N	1.25
LM320T-5	1.25	NE536T	6.00	MC5558V	.59
LM320T-5.2	1.25	NE540L	6.00	8038B	4.95
LM320T-8	1.25	NE544N	4 95	LM75450N	.49
LM320T-12	1.25	NE550N	1.30	75451CN	.39
LM320T-15	1.25	NE555V	.39	75452CN	.39
LM320T-18	1.25	NE556N	99	75453CN	39
LM320T-24	1.25	NE560B	5.00	75454CN	39
LM323K-5	5.95	NE561B	5.00	75491CN	.79
LM324N	1.80	NE562B	5.00	75492CN	.89
LM339N	.99	NE565N/H	1.25	75493N	.89
LM340K-5	1.35	NE566CN	1.75	75494CN	.89
LM340K-6	1.35	NE567V/H	.99	RC4136	1.25
LM340K-8	1.35	NE570N	4 95	RC4151	2.85
LM340K-12	1.35	LM703CN/H	.69	RC4194	5.95
LM340K-15	1 35	LM709N/H	29	RC4195	4 49

74LS00TTL

74LS00	.29			74LS138	89
74LS01	.29	74LS47	.89	74LS139	.89
74LS02	.29	74LS51	29	74LS151	89
74LS03	.29	74LS54	29	74LS155	89
74LS04	35	74LS55	29	74LS157	89
74LS05	35	74LS73	45	74LS160	1.15
74LS08	.29	74LS74	45	74LS161	1.15
74LS09	35	74LS75	.59	74LS162	1.15
74LS10	.29	74LS76	.45	74LS163	1.15
74LS11	.75	74LS78	.49	74LS164	1.25
74LS13	.59	74LS83	.89	74LS175	.99
74LS14	1.25	74LS85	1.25	74LS181	2.49
74LS15	35	74LS86	.45	74LS190	1.15
74LS20	29	74LS90	.59	74LS191	1.15
74LS21	.35	74LS92	75	74LS192	1.15
74LS22	.35	74LS93	75	74LS193	1.15
74LS26	.35	74LS95	.99	74LS194	1.15
74LS27	.35	74LS96	1 15	74LS195	1 15
74LS28	35	74LS107	45	74LS253	.99
74LS30	.29	74LS109	45	74LS257	.89
74LS32	35	74LS112	45	74LS258	1.75
74LS37	.45	74LS123	1.25	74LS260	69
74LS40	.35	74LS125	89	74LS279	.75
74LS42	.89	74LS132	.99	74LS367	75
		74LS136	49	74LS368	.75
				74LS670	2 49

EXCITING NEW KITS

NEW JE600 HEXADECIMAL ENCODER KIT



FEATURES:
- Full 8 bit latched output for micro-processor use
- 3 User Define keys with one being bi-stable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin 1C connector
- Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 . . . . $59.95
Hexadecimal Keypad only $14.95

Digital Thermometer Kit

NEW



- Dual sensors—switching control for in-door/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter Incl.
- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

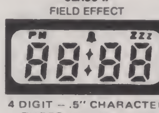
JE300 . . . .$39.95

DISCRETE LEDS

	.200" dia.					
XC556R	red	5/$1			.125" dia.	
XC556G	green	4/$1		XC209R	red	5/$1
XC556Y	yellow	4/$1		XC209G	green	4/$1
XC556C	clear	4/$1		XC209Y	yellow	4/$1
	.200" dia.				.185" dia.	
XC22R	red	5/$1		XC526R	red	5/$1
XC22G	green	4/$1		XC526G	green	4/$1
XC22Y	yellow	4/$1		XC526Y	yellow	4/$1
	.170" dia.			XC526C	clear	4/$1
MV10B	red	4/$1			.190" dia.	
	.085" dia.			XC111R	red	5/$1
MV50	red	6/$1		XC111G	green	4/$1
				XC111Y	yellow	4/$1
				XC111C	clear	4/$1

INFRA-RED LED
1/4"x1/4"x1/16" flat
5/$1

TIMEX T1001
LIQUID CRYSTAL DISPLAY CLASS II
FIELD EFFECT



4 DIGIT – .5" CHARACTERS
THREE ENUNCIATORS
2.00" X 1.20" PACKAGE
INCLUDES CONNECTOR

T1001-Transmissive	$7.95
T1001A-Reflective	8.25

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	99
MAN 72	Common Anode-red	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.99	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	99	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	1.30
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	2.10
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	2.10
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.49
CA3081N	2 00	CA3600N	3 50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7 seg.	
C.A LED driver	1.50

CLOCK CHIPS

MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
MM5841	9.95

MOTOROLA

MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	.$17	.16	.15	22 pin LP	$ .37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

14 pin ST	$.27	.25	.24	28 pin ST	$ .99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin SG	$.30	.27	.24	24 pin SG	$ .70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.65	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

8 pin WW	$.39	.38	.31	22 pin WW	$ .95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	50 PCS	1.75
ASST. 5	5 ea	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	50 PCS	1.75
ASST. 6	5 ea	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	50 PCS	1.75
ASST. 7	5 ea	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

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1979 Catalog Available – Send 41¢ stamp

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TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.95

ICM CHIPS

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ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
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MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.50
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block (Special)	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
2/99¢

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power - Programmable
3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55	JE2206KA	14.95	XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	2.85
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.30	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.39	XR2212	4.35	XR4739	1.15
XR1489	1.39	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
				1N4002	100 PIV	1 AMP	12/1.00
1N746	3.3	400m	4/1.00	1N4003	200 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N752	5.6	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N757	9.0	400m	4/1.00	1N3600	50	200m	6/1.00
1N759	12.0	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965	15	400m	4/1.00	1N4305	75	25m	15/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N5242	12	500m	28	1N4742	12	1w	28
1N5245	15	500m	28	1N4744	15	1w	28
1N456	25	40m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N458	150	7m	6/1.00	1N1184	100 PIV	35 AMP	1.70
1N485A	180	10m	5/1.00	1N1185	150 PIV	35 AMP	1.70
1N4001	50 PIV	1 AMP	12/1 00	1N1186	200 PIV	35 AMP	1.80
				1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1 00	2N4013	3/1.00
TIS98	8/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369	5/1.00	MPS3705	5/1.00	2N5087	4/1.00
2N2369A	4/1.00	2N3706	5/1.00	2N5088	4/1.00
MPS2369	5/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2484	4/1 00	2N3707	5/1.00	2N5129	5/1.00
2N2906	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2907	5/1.00	2N3724A	.65	PN5138	5/1.00
PN2907 Plastic	7/1.00	2N3725A	1.00	2N5139	5/1.00
2N2925	5/1.00	2N3772	2.25	2N5210	5/1.00
MJE2955	1.25	2N3823	1.00	2N5449	3/1.00
2N3053	2/1 00	2N3903	5/1 00	2N5951	3/1 00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	05	.04	.03	047µF	.06	.05	.04
470 pf	.05	.04	035	1µF	12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	17
.01mf	12	10	.07	22mf	33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	32	.28	.23
47/35V	28	23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	15/25V	.63	.50	.40
1.0/35V	.28	.23	17				
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				Radial Lead			
.47/50V	15	.13	.10	47/25V	15	13	10
1.0/50V	16	.14	11	.47/50V	16	14	.11
3.3/50V	14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	15	.13	10	1.0/25V	16	14	11
10/25V	.15	.13	.10	1.0/50V	16	14	11
10/50V	.16	.14	12	4.7/16V	.15	.13	.10
22/25V	.17	.15	12	4.7/25V	.15	.13	.10
22/50V	.24	.20	18	4.7/50V	16	14	.11
47/25V	19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	19	10/25V	15	13	.10
100/25V	.24	.20	18	10/50V	16	.14	.12
100/50V	.35	30	28	47/50V	24	.21	19
220/25V	.32	.28	.25	100/16V	19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

✓J1

Transistor Checker



— Completely Assembled —
— Battery Operated —

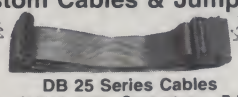
The ASI Transistor Checker is capable of checking a wide range of transistor types, either "in circuit" or out of circuit. To operate, simply plug the transistor to be checked into the front panel socket, or connect it with the alligator clip test leads provided. The unit safely and automatically identifies low, medium and high-power PNP and NPN transistors. Size: 3¾" x 6¼" x 2"

"C" cell battery not included.

ON SALE!

Trans-Check $19.95 ea.

Custom Cables & Jumpers



NEW NEW

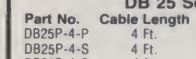
DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft.	2-DP25P	$15.95 ea.
DB25P-4-S	4 Ft.	1-DP25P/1-25S	$16.95 ea.
DB25S-4-S	4 ft.	2-DP25S	$17.95 ea.

Dip Jumpers

DJ14-1	1 ft.	1-14 Pin	$1.59 ea.
DJ16-1	1 ft.	1-16 Pin	1.79 ea.
DJ24-1	1 ft.	1-24 Pin	2.79 ea.
DJ14-1-14	1 ft.	2-14 Pin	2.79 ea.
DJ16-1-16	1 ft.	2-16 Pin	3.19 ea.
DJ24-1-24	1 ft.	2-24 Pin	4.95 ea.

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing



CONNECTORS
25 Pin-D Subminiature

DB25P (as pictured)	PLUG (Meets RS232)	$2.95
DB25S	SOCKET (Meets RS232)	$3.50
DB51226-1	Cable Cover for DB25P or DB25S	$1.75

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out — Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100 (.100 Spacing)	PINS (Wire Wrap)	$6.95
50/100 (.125 Spacing)	PINS (Wire Wrap) R681-1	$6.95

4-Digit Clock Kit



* Bright .357" ht. red display
* Sequential flashing colon
* 12 or 24 hour operation
* Extruded aluminum case (black)
* Pressure switches for hours, minutes & hold functions
* Includes all components, case and wall transformer
* Size: 3⅛ x 1¾ x 1¼

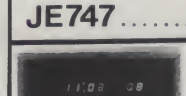
JE730 ..... $14.95

Jumbo 6-Digit Clock Kit



* Four .630"ht. and two .300"ht. common anode displays
* Uses MM5314 clock chip
* Switches for hours, minutes and hold functions
* Hours easily viewable to 30 feet
* Simulated walnut case
* 115 VAC operation
* 12 or 24 hour operation
* Includes all components, case and wall transformer
* Size: 6¾ x 3⅛ x 1¾

JE747 ..... $29.95

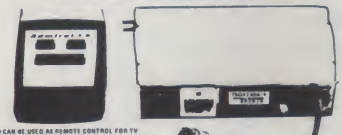


- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3 1/8" x 1¾"

JE701

6-Digit Clock Kit $19.95

REMOTE CONTROL TRANSMITTER & RECEIVER



- CAN BE USED AS REMOTE CONTROL FOR TV
- USE IT FOR YOUR OWN GARAGE DOOR OPENER
- TRANSMITS BETWEEN 260 MHz AND 61.5KHz
- THOUSANDS OF USES FOR REMOTE CONTROL APPLICATIONS
- TRANSMITTER USES A 9 V BATTERY
- SCHEMATIC INCLUDED

$19.95

Digital Stopwatch Kit



* Use Intersil 7205 Chip
* Plated thru double-sided P.C. Board
* LED display (red)
* Times to 59 min. 59.59 sec. with auto reset
* Quartz crystal controlled
* Three stopwatches in one: single event, split (cummulative) & taylor (sequential timing)
* Uses 3 penlite batteries
* Size: 4.5" x 2.15" x .90"

JE900 $39.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$ 9.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	5.95
8238	System Controller	5.95
8251	Prog. Comm. I/O (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. I/O (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$19.95
Z80A(780-1)	CPU	24.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, I/O lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	50
MM504H	Dual 16 Bit Static	50
MM506H	Dual 100 Bit Static	50
MM510H	Dual 64 Bit Accumulator	50
MM5016H	500/512 Bit Dynamic	89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
2533	1024 Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49

UART'S

A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

ROM'S

2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

RAM'S

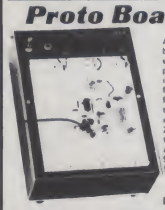
1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	9.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00

PROM'S

1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516	16K*	EPROM	49.95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716 T.I	16K**	EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

CSC CONTINENTAL SPECIALTIES

Proto Board 203



A total ready-to-use power breadboard prototest device with a built-in regulated, short proof power supply. Just plug in and start building! 2 extra floating 5-way binding posts for external signals. Self-contained with power switch, indicator lamp and power fuse. 24 14 pin DIP capacity. Attractive two-tone quality case. All metal construction. 9¾"L x 6¼"W x 2¾"H 5 lbs.

PB 203 $75.00

Model Number	L x W x H (Inches)	Price
PB-6	6.0 x 4.5 x 1.4	$15.95
PB-100	6.0 x 4.5 x 1.4	$19.95
PB-101	6.0 x 4.5 x 1.4	$22.95

Proto Board 203A



All the features of the PB-203 plus additional power supply flexibility, provides 1% Regulated 5VDC supply (same specifications as PB 203). Regulated separate +15VDC and —15 VDC 0.5A supplies, each with internally and independently adjustable output voltage. Ripple and noise of + and —15V supplies, 10mV at 0.25A.

PB 203A $124.95

Model Number	L x W x H (Inches)	Price
PB-102	7.0 x 4.5 x 1.4	$26.95
PB-103	9.0 x 6.0 x 1.4	$44.95
PB-104	9.8 x 8.0 x 1.4	$54.95

62-Key ASCII Encoder Keyboard Kit



The JE610 62-Key ASCII Encoder Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and —12V @ 10mA for operation.

FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

JE610 ..... $79.95

62-Key Keyboard only . . $34.95

REGULATED POWER SUPPLY NEW

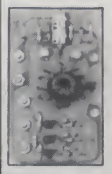
JE200 5V-1 AMP POWER SUPPLY



- Uses LM309K
- Heat sink provided
- PC Board construction
- Provides a solid 1 amp @ 5 volts
- Can supply up to ±5V, ±9V and ±12V with JE205 Adapter
- Includes components, hardware & instructions
- Size: 3½"x5"x2"H

JE200 $14.95

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- DC/DC converter w/ +5V input
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- Short circ. protection
- PC Brd. construction
- Piggy-back to JE200 board
- Size: 3½"x2"x9/16"h

JE205 $12.95

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$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud.
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark.
Transmit Channel Frequencies	Switch selectable. Low (normal) = 1070 space, 1270 mark, High = 025 space, 2225 mark
Receive Sensitivity	46 dbm accoustically coupled
Transmit Level	—15 dbm nominal. Adjustable from —6 dbm to —20 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

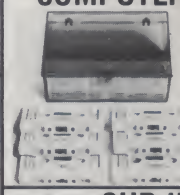
TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K. Kit comes complete with:

* 8 each UPD416-1 (16K Dynamic Rams) 250NS
* Documentation for conversion

TRS-16K $75.00

COMPUTER CASSETTES



- 6 EACH 15 MINUTE HIGH QUALITY C-15 CASSETTES
- PLASTIC CASE INCLUDED 12 CASSETTE CAPACITY
- ADDITIONAL CASSETTES AVAILABLE #C-15-$2.95 ea

CAS-6 $14.95 (Case and 6 Cassettes)

SUP 'R' MOD II
UHF Channel 33 TV Interface Unit Kit



Wide Band B/W or Color System

★ Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.

MOD II is pretuned to Channel 33 (UHF).

★ Includes coaxial cable and antenna *transformer.*

MOD II $29.95 Kit

Function Generator Kit



- Provides 3 basic waveforms: sine, triangle & square wave
- Frequency range from 1 Hz to 100K Hz
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- Uses a 12V supply or a ±6V split supply
- Incl. chip, P.C. board, components and instructions.

JE2206B $19.95

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"Plug/Jack interface to any computer system requiring remote control of cassette functions"

The CC100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Eliminates the plugging and unplugging of cables during computer loading operation from cassette.

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16K - Keyboard B	$ 995
16K - Keyboard N	$ 995
32K - Keyboard C	$1195
32K - Keyboard B	$1195
32K - Keyboard N	$1195

C — calculator keyboard (only version with tape deck)
B — Large Keyboard (graphics not on keys)
N — large keyboard with graphics symbols

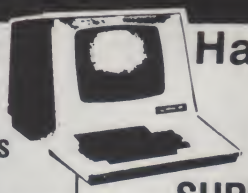
Used 8K PET with 90-day warranty $650

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Commodore Printer (tractor feed)	$995.00
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apple II plus

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The new Apple II with Applesoft BASIC built-in! Eliminates the need for a $200 Firmware Card and includes new Autostart ROM for easy operation. This combined with the FREE accessories from NCE could save you up to $400 on a 48K Apple II system!

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32K Apple II Plus — $1345 (take $150 in free accessories)
48K Apple II Plus — $1495 (take $200 in free accessories)

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Now you can print high resolution graphics from your Apple using the IP-225 printer and graphics option from IDS. The IP-225 is a tractor feed printer with 96 possible characters. Line length is 80/132 col. with a speed of 50/80 cps. We include software which allows it to use either parallel or serial interface at 1200 baud, ABSOLUTELY FREE (you save $50)!

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REMOTE TERMINAL for only $69

A self-contained module and program cassette enables your PET to function as a 300 baud terminal. Supports Upper/Lower case, Rubout, Escape & all control functions. Output is TTL.

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DISK & MEMORY EXPANSION

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CAT COUPLER

New 300 baud Originate/Answer Acoustic Coupler. Looks good, works great priced at $189

LOW COST PRINTER FOR PET

$395

This is a completely refurbished Teletype KSR 33 terminal ready to attach to your PET's interface to use as a printer.

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SPECIAL OF THE MONTH

Desktop Selectric-Based Terminal $319!

Super bargain while they last: A desktop terminal based on an IBM Selectric typewriter for only $319 including documentation. These terminals were originally designed for use with timesharing systems where top-quality printing was required. The IBM keyboard and printer are separated by a three foot cable and each has its own enclosure (great for custom installations). Serial RS-232 interface uses PTTC instead of ASCII codes so you will need to write a conversion program (we have no ASCII interface for this model). 14.8 cps, 134.5 baud 13" line length, pica. Sold in "AS-IS" condition, our warranty is limited to replacement of missing parts (we check all motors).

FREE SANYO MONITOR when you buy the SORCERER

A $169 VALUE

$995

Z-80 Processor • Full-size keyboard • User definable characters • Up to 32K on-board RAM • Interchangeable ROM PACs • 30 x 64 display • Resident 4k monitor ROM • Dual Cassette I/O • Serial and Parallel I/O • Complete operator's manual

Simply add a monitor and tape decks to complete the system. Can be used as a terminal. Microsoft BASIC ROM PAC is standard. NEW! Exidy Word Processing ROM PAC now available which handles tabs, search/replace, etc., many different printers and can be used with cassette or disk. The most flexible W/P system we've ever seen.

Sorcerer 8K	$995
Sorcerer 16K	$1150
Sorcerer 32K	$1395
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9-inch	15-inch
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COMPUCRUISE

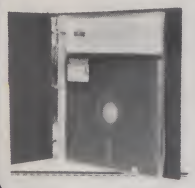
Put a computer in your car, which gives you the most effective and functional cruise control ever designed, plus complete trip computing, fuel management systems, and a remarkable accurate quartz crystal time system.

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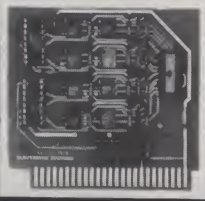
FLOPPY DISK STORAGE BINDER

This black vinyl three-ring binder comes with ten transparent plastic sleeves which accommodate either twenty, five-inch or ten, eight-inch floppy disks. The plastic sleeves may be ordered separately and added as needed. A contents file is included with each sleeve for easy identification and organizing. Binder & 10 holders $14.95 Part No. B800; Extra holders 95¢ each. Part No. 800



OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II

There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection.
Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.



TIDMA

• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only $35.00 Part No. 112, with parts $110 Part No. 112A

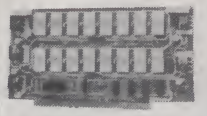


SYSTEM MONITOR

8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

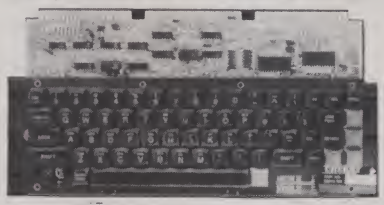
16K EPROM

Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.



ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $135.00.



ASCII KEYBOARD

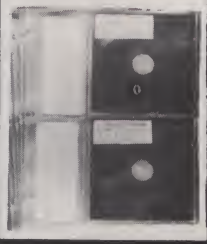
53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $229.95. Part No. TA 1000C

DISK JACKET™

Made from heavy duty .0095 matte plastic with reinforced grommets. The mini-diskette version holds two 5-1/4 inch diskettes and will fit any standard three ring binder. The pockets to the left of the diskette can be used for listing the contents of the disk. Please order only in multitudes of ten. $9.95/10 Pack.



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English, French, Danish, German, Italian, Hungarian, Norwegian, Polish, Spanish, Swedish. 10 languages, 28 pp. SYBEX. Ref. IMD. $4.95

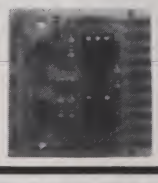
VIDEO TERMINAL

16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • RS-232 in • RS-232 out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & -16 VDC at 100mA, and 8VDC at 1A. Part no. 1000A $199.95 kit.



RS-232/20mA INTERFACE

This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.



COMPUCOLOR II

Model 3, 8K	$1,395.
Model 4, 16K	$1,595.
Model 5, 32K	$1,895.

Prices include color monitor, computer, and one disk drive.



PET COMPUTER

With 32K & monitor - $1195. Dual Disk Drive - $1195.



apple II or APPLE II PLUS

16K - $995, 32K - $1059, 48K - $1123. Disk & cont $589



6502 APPLICATIONS BOOK Z80 APPLICATIONS BOOK*

This book will teach you how to connect a board to the outside world and implement practical applications for the 6502, (or Z80). Applications range from home control (a complete alarm system, including heat sensor), to industrial applications. You will learn techniques ranging from simulated traffic control to analog-digital conversion. All experiments can be realized with a minimum of external (low-cost) components. They are directly applicable to any 6502-based board such as SYM, KIM, AIM 65. This book also studies in detail input-output techniques and components, and is the logical continuation of C202 (or C280). By Rodney Zaks. SYBEX. 6502: Ref. D302; Z80: Ref D380. Each $12.95

T.V. INTERFACE

● Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple ● Power required is 12 volts AC C.T., or +5 volts DC ● Board only $7.60 part No. 107, with parts $13.50 Part No. 107A



PARALLEL TRIAC OUTPUT BOARD FOR APPLE II



This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A.

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U.S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. 24 hour order line (408) 226-4064.

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E21

TRS-80 E.S. SERIAL I/O

• Can input into basic • Can use LLIST and LPRINT to output, or output continuously • RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line • Requires +5, -12 VDC • Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010 C. No connectors provided, see below.



EIA/RS-232 connector Part No. DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9



3' ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No. 3CAB40.



MODEM

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 Ω speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board only $7.60 Part No. 109, with parts $27.50 Part No. 109A

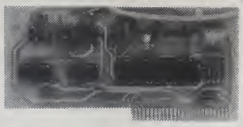


DISKETTES



Box of 10, 5" $29.95, 8" $39.95.
Plastic box, holds 10 diskettes, 5" - $4.50, 8" - $6.50.

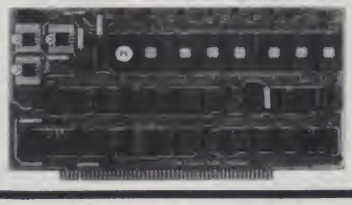
APPLE II* SERIAL I/O INTERFACE



Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Also watches DTR • Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

8K EPROM PIICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. • S-100 bus compatible • Room for 8K bytes of EPROM non-volatile memory (2708's). • On-board PROM programming • Address relocation of each 4K of memory to any 4K boundary within 64K • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software available • Solder mask both sides • Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.



T.V. TYPEWRITER

• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A



TAPE INTERFACE

• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $27.50 Part No. 111A



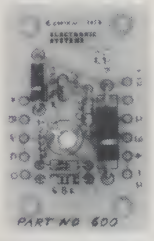
RS-232/ TTL INTERFACE

• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only $4.50 Part No. 232, with parts $7.00 Part No. 232A 10 Pin edge connector $3.00 Part No. 10P



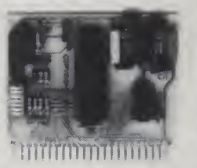
RS-232/TTY INTERFACE

This board has two active circuits, one converts RS-232 to 20mA, and the other converts 20mA to RS-232. Requires +12 and -12 volts. Board only $4.50 Part No. 600, with parts $7.00 Part No. 600A.



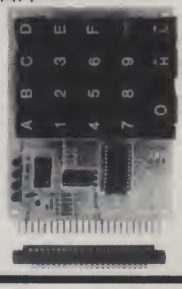
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• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P



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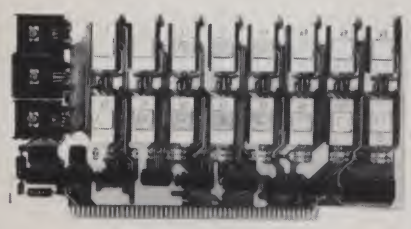
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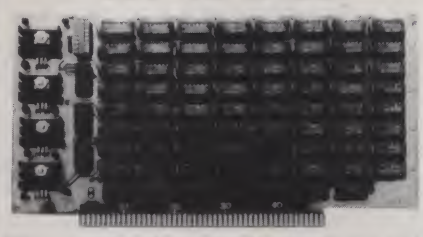
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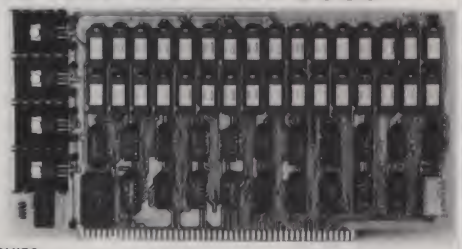
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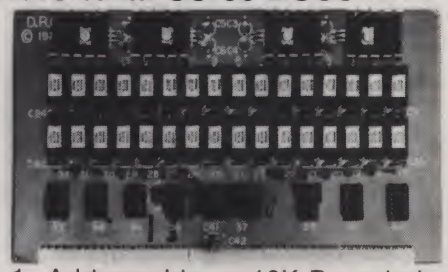
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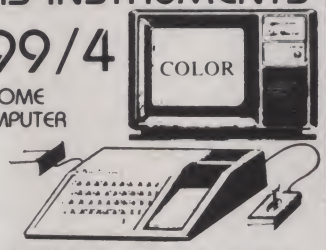
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Features Include: S-100 Compatible ■ Two serial I/O Ports using software-programmable UARTS ■ One general purpose latched parallel I/O Port ideal for printer interface or control ■ Switch selectable ■ On board "Kansas City" standard cassette interface useable upto 1200 Baud, allowing storage of up to 180,000 bytes on a 30 minute audio cassette.

Assembled and Tested		Kit	
IOI-1040A.	$179.95	IOI-1040K,	$124.95

Bare Board with Manual IOI-1040B. $30.00

SYM-1 $245

Part Number:CPK-5002A

6502- BASED SINGLE BOARD COMPUTER WITH KEYBOARD/DISPLAY, KIM-1 HARDWARE COMPATIBLE, COMPLETE DOCUMENTATION.

SYM-1 CASE, ENX-000005 ..... $39.95

THE BIG Z

THE NEW Z-80 CPU BOARD FROM JADE

Features Include: ■ S-100 Compatible, available in 2MHz or 4MHz versions ■ On-board 2708, 2716, 2516, or 2532 EPROM can be addressed on any 1K, 2K, or 4K boundary, with power-on jump to EPROM. ■ On-board EPROM may be used in SHADOW mode, allowing full 64K RAM to be used. ■ Automatic MWRITE generation if front panel is not used. ■ On-board USART for synchronous or asynchronous RS232 operation (on-board baud rate generator). ■ Reverse-channel capability on USART allows use with buffered peripherals or devices with "not-ready" signal.

2MHz-		BARE BOARD CPU-30200B....$40.00	4 MHz-	
Kit: CPU-30200K, 2 lbs	$149.95		Kit: CPU-30201K, 2 lbs	$159.95
Assembled and Tested: CPU-30200A, 2 lbs	$199.95		Assembled and Tested - CPU-30201A, 2 lbs	$209.95

GRI KEYBOARDS

Features Include: Full 128 character ASCII ■ Tri-Mode Mos encoding ■ MOS/DTL/TTL compatible output ■ Two-key rollover ■ Level and pulse strobe ■ Shift and alpha lock ■ Selectable parity ■ Positive or Negative Logic ■ All new OEM grade components ■ Gold contact, low bounce keyswithces ■ Rugged G-10 printed circuit board ■ Custom 2 shot molded keycaps ■ Low power consumption ■ Optional numeric pad available ■ Custom enclosures available.

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Assembled- KBA-30756A $79.95
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Kit- KBA-30753K $65.95

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DB25S- CND1252 ..... $3.25
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8238	$6.40
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8251	$7.50
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8255	$6.40
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8259	$18.00
8275	$51.20
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S2350	$10.95
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2708	$9.95
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2716 (5v)	$49.95
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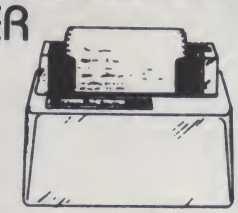
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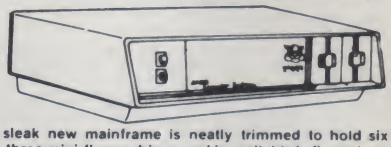
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- 96 Character ASCII Set
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- Eight software selectable Character sizes
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This sleak new mainframe is neatly trimmed to hold six S-100 boards, three mini-floppy drives, and is available in five colors. Power requirements: 115/220 VAC, 50/60 HZ. Weight: 27 lbs. (with drives). Dimensions: 21.375" Wide X 8.4" High X 15.875" Deep. Power Supply: 8 volts at 18 Amps unregulated, + 16 volts at 3 amps unregulated, - 16 volts at 3 amps unregulated, + 5 volts at 3 amps regulated, + 12 volts at 3 amps regulated.

THE PIGGY IS HERE!

THE PIGGY (Without Drives) $475.00

PART NUMBER: ENS-106320

MEM-2
16 K Static RAM Board

Kit (450ns)	$250.00
Kit (250ns)	$285.00
Assembled (450ns)	$325.00
Assembled (250ns)	$350.00

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Part No.	positions 1-9		Part No.	positions 1-9	
SWD-103	3	$1.18	SWD-107	7	$1.30
SWD-104	4	$1.20	SWD-108	8	$1.34
SWD-105	5	$1.24	SWD-109	9	$1.36
SWD-106	6	$1.28	SWD-110	10	$1.38

DYNAMIC RAM BOARDS
EXPANDABLE TO 64K
32K VERSION • KITS

Uses 4115 (8K x 1, 250ns) Dynamic RAM's, can be expanded in 8K increments up to 32K

8K $159.95 24K $249.95
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Uses 4116 (16K x 1, 200ns) Dynamic RAM's, can be expanded in 16K increments up to 64K

16K $249.95 48K $469.95
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STATIC RAM BOARDS

JADE 8K

Kits:	450ns	$125.95
	250ns	$149.75
Assembled & Tested:		
	450ns	$139.75
	250ns	$169.75
Bare Board:		$ 25.00

32K Static

Assembled & Tested:	
250ns	$795.00
450ns	$725.00
250ns Kit	$575.00

L.S. Engineering EPROM Eraser

Features Include: Erases up to 48 I.C.s at a time • Uses popular (and readily available 12" shortwave UV bulbs) • Handsome smoke-plastic case • Includes bulb • Just plug it in and you're ready to go!

XME-3200, ... $39.95

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MINI-DISK CABLE KIT: To connect two 5 1/4 drives to disk controller board. Contains assembled and tested 5 long signal cable with 34 pin edge connectors. Also includes cables and connector for D.C. power supply.
WCA-3431K $34.95

8 DISK CABLE KIT: To connect two 8 disk drives to edge-type controller (e.g., Versafloppy, Double-D). Contains assembled and tested signal cable with connectors plus cable and connectors for both A.C. and D.C. power.
WCA-5031K $38.45

8 DISK CABLE KIT: Same as WCA-5031K except controller end of signal cable uses Header type connector, e.g., for Tarbell Controller.
WCA-5032K $38.95

SIGNAL CABLE ONLY: For one 5 1/4 drive to edge type controller connector (e.g., TRS-80 to Vista Disk Drive).
WCA-3421A $24.95
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JADE FLOPPY DISK SPECIAL

INCLUDES: ■ Two Siemens/GSI 8" Floppy Disk Drives ■ Power Supply ■ Jade Double Density Board (Kit) ■ CP/M™ Operating System with Basic ∈ (CP/M is a registered trademark of Digital Research) ■ Package of 10 Blank 8" Diskettes (Double Density) ■ Interface Cables.

IF purchased seperately this package would cost: $1544.95.

JADE SPECIAL
$1225.00

SPECIAL

5¼" Diskettes
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SPECIFY SOFT, 10, or 16 SECTOR

8" SINGLE SIDE, SINGLE DENSITY
$34.95/Box of TEN

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- 8" or 5¼" DRIVES
- CP/M COMPATIBLE IN EITHER DENSITY
- ON-BOARD Z80 CPU ALLOWS UNIVERSAL SYSTEM COMPATIBILITY
- PROGRAMMED DATA TRANSFER - NO DMA
- CONTROLS UP TO 8 DRIVES
- SOFTWARE SELECTABLE DENSITY

Our new controller utilizes the IBM standard formats for proven reliability. Data recovery is enchaced through use of a phase-locked-loop data seperation circuit and write precompensation. Single and double density diskettes can be mixed in the same system.

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IOD-1200A, 2 lbs. . . $299.95
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IOD-1200K, 2 lbs. . . $249.95
Bare Board w/ Manual
IOD-1200B, 2 lbs. . . $55.00
Manual
IOD-1200M, 1 lb. . . $10.00

VB-1B VIDEO INTERFACE

S-100 Compatible Serial Interface with Sockets Included.

Kit	$117.95
Assembled & Tested	$159.95
Bare Board w/manual	$ 35.00

FLOPPY DISK INTERFACE

JADE FLOPPY DISK (Tarbell board)

JADE KIT	$190.00
Assembled & Tested	$260.00

S.D. Computer Products VERSA-FLOPPY

Kit	$159.95
Assembled & Tested	$239.00

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MPI B51 5 1/4" MSM—155100 $295.00
Single or double density, up to 40 tracks, track to track access time only 5ms.

MPI B52 5 1/4" MSM-155200 $450.00
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Single Density, 35 Track

Siemens FDD100-8 8" $495.00
Shugart 801R replacement, Single or double density, runs cooler and quieter.

Siemens FDD200-8 8" $575.00
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Shugart 801R 8" $575.00
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Vista V80 Mini Disk SYSTEM FOR TRS—80
$395.00



PART NUMBER: MSM-358000

Includes disk drive, power supply, regulator board, and compact case. The V-80 offers 23% more storage capacity. Simply take it out of the box, plug in the cable, and it's ready to run. Requires 16K, Level II, expansion interface.

Interface Cable .. $24.95
PART NUMBER: WCA-3421A

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PSD 249A For a Single 5 1/4 Disk Drive. By Power One or Alpha Power +5V at 7A, +12V at 1.1A .. $52.00

PSD 205A For Single 8 Disk Drive. By Power One 5V at 1A 5V at 5A 24V at 1.5A $89.95

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PSX 030A $59.95

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Comes in either 6, 12, or 18 slot sizes. These boards with a special ground plane assure a silent operation.

JADE 6 Slot

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Assembled	$59.95
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Kit	$89.95
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Kit	$129.95
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✓J6

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PCBD $26.95
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PT-2 PROTO BOARD. Similar to PT-1 except set-up to handle solder tail sockets.
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PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies require textool sockets. Kit $124.95

CB-1 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status Kit $119.00 PCBD $30.95

MB-6B Basic 8KX8 ram uses 2102 type rams, S-100 buss. Kit 450 NSEC $139.95 PCBD $26.95

MB-7 16KX8, Static RAM uses μP410 Protection, fully buffered Kit $299.95

MB-8A 2708 EROM Board. S-100, 8K8X or 16Kx8 kit without PROMS $75.00 PCBD $28.95

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IO-2 S-100 8 bit parallel /IO port, ⅔ of boards is for kludging. Kit $46.00 PCBD $26.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports.
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WAMECO INC.

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remic 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM " (not included).
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QM-9 MOTHER BOARD, Short Version of QM-12. 9 Slots PCBD $30.95

MEM-2 16K x 8 Fully Buffered 2114 Board PCBD $26.95

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8224	3.49	2102A-2L	1.50
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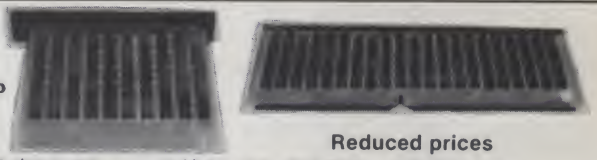
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Ideal for micro and mini computers. These units have been removed from equipment, checked out and guaranteed. 5 volts @ 8 amps + 12 volts. 2 amps + 6 volts @ 75 MA. Power supply has a 3-wire line cord and fused. Dimensions: 10½"x5½"x4½". Shipping weight: 16 lbs.

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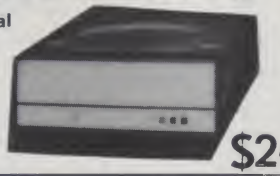
Reduced prices

Smaller board measures 6½"x6" and has 40 to 50 sockets. ~~Price $11.00 ea. 2/$20.00~~ $7.50 ea.2/$14.00

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SERIES 40 MODEL 43 100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM: 2400, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.



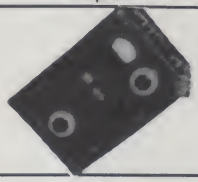
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MEASUREMENTS MODEL 560 FM

Frequency 25 mhz to 80 mhz and 130-175 mhz. Dimensions: 10"x10"x16", weight: 16 lbs. Shipped freight collect. Used. Checked out and operating.

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Primary: 230/115V, 50/60 CPS, Secondary: VA output 250V. **$13.95 EACH**

I.C.'s

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7450	.23	74H72N	.30
7453	.23	74H73N	.40
7460	.23	74H76N	.45
7470	.25	74H87N	1.30
7482	.50	74H101J	.65
7490	.35	74H103J	.50
7491	.65	74H108J	.50
74104	.30	74H50	.23
74111	.35	74H40	.23
74121	.30	74H51	.23
74122	.45	74H21	.23
74142	.90	74H30	.23
74145	.45	74SO9	.23
74156	.35	74S134	.25
74180	.45	74S135	.45
74198	1.45	75150	.85
74249	.45	75154	1.25
74265	.35	LM101H	.75
74HO5N	.25	LM318H	1.25
74H15N	.40	NE531T	.80
74H22J	.30	NE565A	.75
74H60N	.23	LM556CN	.75
74H61J	.30	74H61N	.23
74H71N	.30	CA324G	.50
RC741DP	.18	RC747DP	.30

MEMORY PHONES

By FORD INDUSTRIES, INC.

These units have complete installation and operating instructions w/6-foot cord. Colors: beige, white, green, Used, operating condition.

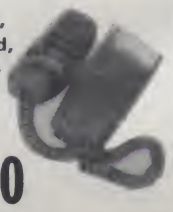


$89

TRENDLINE PHONES

Mfd. by I.T.T.

Rotary dial. Colors: white, black, red, green. Packaged, has 6-foot cord and installation instructions. Used, operating condition.

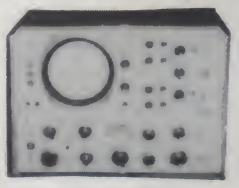


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HEWLETT-PACKARD
Model 175A

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These scopes have a 50 Mhz bandwidth and have 2 plug-ins, a 1781B Delay generator and a model 1755A Dual trace vertical amplifier. Dimensions: 13"x17"x25", weight 71 lbs. shipped freight collect. 5" scope. Used. Checked out and operating.



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13.95

INCANDESCENT READOUT ASSEMBLY

Readouts assembled of the 710 series modules. Character 1" high w/lamps. Type No. 344. By Dialco.



1.50 EACH

I.C. SOCKETS

14-PIN Wire Wrap	.30
14-PIN Low Profile	.15
28-PIN Low Profile	.35
40-PIN Low Profile	.50

Minimum order $25.00. Items offered subject to prior sale. FOB, Brockton, Mass. Money order or check w/order. Shipping and handling add 5%. Shipments by parcel post or UPS. No CODs. Mass. residents add 5% sales tax.

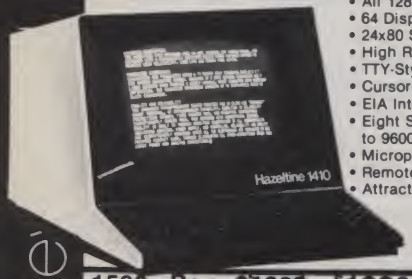
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TRS-80 DISC DRIVE



$395.00

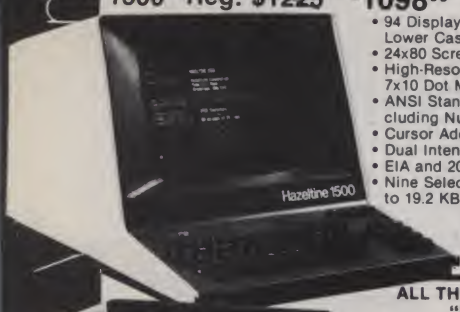
Shugart SA400, housed in an attractive metal case, complete with power supply and termination network. All you need to do is connect the drives to your expansion interface.



1410 $835.00

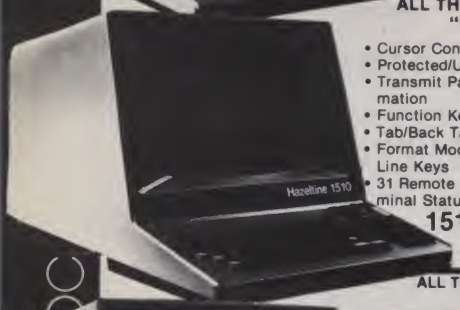
- Separate integral 12-key Numeric Pad
- All 128 ASCII Codes
- 64 Displayable Characters
- 24x80 Screen Configuration
- High Resolution using a 5x7 Dot Matrix
- TTY-Style Keyboard Layout
- Cursor Addressing and Sensing
- EIA Interface
- Eight Selectable Transmission Rates up to 9600 Baud
- Microprocessor Based
- Remote Commands
- Attractive Styling for Contemporary Environments

Hazeltine 1400
same as 1410 less numeric pad
$735.00



1500 Reg. ~~$1225~~ $1098.00

- All 128 ASCII Codes
- 94 Displayable Characters Including Lower Case
- 24x80 Screen Configuration
- High-Resolution Characters Using a 7x10 Dot Matrix
- ANSI Standard Keyboard Layout including Numeric Pad
- Cursor Addressing and Sensing
- Dual Intensity
- EIA and 20MA Interface
- Nine Selectable Transmission Rates Up to 19.2 KB
- Auxiliary EIA Output
- Remote Editing Commands
- Standard or Reverse Video
- Microprocessor Based



ALL THE FEATURES OF THE "1500" PLUS . . .

- Cursor Control Keys
- Protected/Unprotected Data
- Transmit Page, Line or Batches of Information
- Function Keys—up to 127
- Tab/Back Tab/Auto Tab
- Format Mode with Insert and Delete Line Keys
- 31 Remote Commands including "Terminal Status"

1510 Reg. ~~$1805~~ $1175



ALL THE FEATURES OF THE "1510" PLUS . . .

Separate Microprocessor-Controlled Printer Interface which allows:

- Interfacing of both serial and parallel printers
- Printer speed independent of communications baud rate
- Printer control codes to be sent by the CPU and received by the printer without restriction or alteration of the terminal (especially useful for wide carriage applications)
- Information to be transmitted directly to either the printer or the terminal, or to both
- Operating Modes/Remote Commands; Remote/Local Print; Printer On-Line with/without Display; Printer Off-Line

1520 Reg. ~~$1650~~ $1495.00

PRICE DOES NOT INCLUDE SHIPPING

CENTRONICS 779 PRINTERS

- Use with TRS-80
- Parallel interface
- Continuous variable printing density 80-132 characters per line
- 5x7 dot matrix
- Prints on plain paper, sheets, rolls, fan fold
- Form thickness control
- Horizontal and vertical form positioning



779-1 pinch roll friction feed
Reg. $1250 **$950.00**
779-2 tractor feet
Reg. $1400 **$1050.00**

Call for Discount Prices on Other Centronics Printers

Portable Miniscopes for Electronic Professionals on the Go!!! The Standout Oscilloscope development of the decade!!! Now -30MHz, dual trace model. Compare the performance, then compare the price.



NLS

1¢ sale Probes 1¢ with purchase of scope

• 30-Megahertz bandwidth • Accuracy 3% full scale. • Internal, line or external trigger. • Batteries and charger/transformer unit included • Graticule: 4x5 divisions, each division 0.25" • Time base: 1 micro sec. to 0.5 sec/div 21 settings • Verticle Gain: 0.01 to 50 Volts/div. 12 settings • Size 2.9"H x 6.4"W x 8.5"D. 3.5 lbs. • TEST MOST DIGITAL LOGIC CIRCUITS INCLUDING MICROPROCESSORS •.

41-141	Deluxe 10tol probe with 4 interchangeable tips	**$27.00**
41-37	Deluxe 10tol/1tol probe with 4 interchangeable tips	**$38.50**
41-180	leather carrying case	**$45.00**
MS-15	Single trace 15 MHz	**$318.00**
MS-215	Dual trace 15 MHz	**$435.00**

3M Scotch® Brand DISKETTES

Part #	Sides/ Density	Sectoring	Price Box of 10
		8"	
740-OP	1/single	Soft-IBM	$39.95
740/2-OP	2/single	Soft-IBM	$75.00
740-32P	1/single	32-Shugart 801	$39.95
740/2-32P	2/single	32-Shugart 801	$75.00
741-O	1/double	Soft-Shugart Dbl	$59.00
		5"	
744-OK	1/single	Soft-Shugart SA400 (TRS-80)	$51.00*
744-10K	1/single	Soft/10 SA400	$51.00*
744-16K	1/single	Soft/16 Micropolis	$51.00*

*Price Includes Kas-ette/10 Storage Box a $5.00 Value

"DON'T SETTLE FOR ANYTHING LESS THAN SCOTCH"



ACOUSTIC MODEM
NOVATION CAT

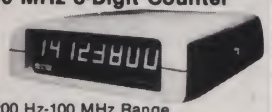
- 0-300 Baud
- Bell 103
- Answer, Originate

Reg. $198.00
Sale $189.00

CONTINENTAL SPECIALTIES CORPORATION

CSC

100 MHz 8-Digit Counter



- 200 Hz-100 MHz Range
- 6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable - completely self contained
- Size - 1.75" x 7.38" x 5.63"
- Four power sources, i.e. batteries. 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply.

~~$134.95~~ **Sale $120.00**

ACCESSORIES FOR MAX 100:
Mobile Charter Eliminator use power from car battery **Model 100-CLA $3.95.**
Charger/Eliminator use 110 VAC **Model 100 — CAI $9.95**

CONTINENTAL SPECIALTIES CORPORATION

CSC

SALE



REG. ~~$59.95~~

LOGIC MONITOR 1

Trace signals through all types of digital circuits. Unit clips over any DIP IC up to 16 pins. Each of its 16 contacts connects to a single-bit level detector that drives a high-intensity, numbered LED readout activated when the applied voltage exceeds a fixed 2 V threshold. Logic "1" turns LED on; logic "0" keeps LED off. A power-seeking gate network automatically locates supply leads and feeds them to the LM-1's internal circuitry. Saves minutes, even hours in design, troubleshooting, debugging of equipment. **Voltage Threshold:** 2 V ± 0.2 V. **Input Impedance:** 100,000 ohms. **Input Voltage Range:** 4-15 V max. across any two or more inputs. **Current Drain:** 200 mA at 10 V. **Size:** 4" l. x 2" w. x 1.75" d. when open. **Weight:** 3 ozs.

CSC Model LM-1 Logic Monitor—Complete.
Sale Price **$54.95**

VISA master charge

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Prices subject to change without notice.
We will do our best to maintain prices thru Sept. 1979.

✓P21

phone orders welcome (213) 894-8171, (800) 423-5633

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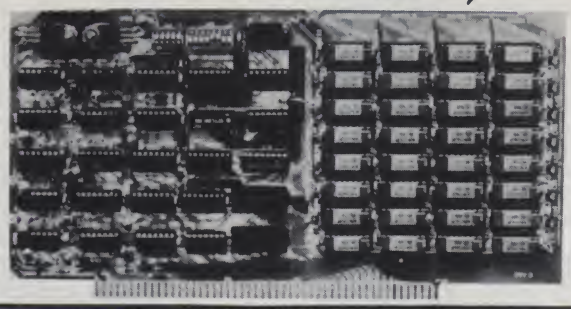
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SD EXPANDORAM

The Ultimate S-100 Memory

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

- Interfaces with Altair, IMSAI, SOL-8, Cromenco, SBC-100, and others.
- Bank Selectable
- Phantom
- Power 8VDC, ±16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.

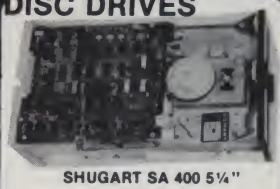


- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's.

EXPANDO 64 KIT (4116)

16K	$249
32K	$324
48K	$399
64K	$474

DISC DRIVES



SHUGART SA 400 5¼"
110 KB, 35 tracks,
SHUGART SA 400 **$295.00**

SHUGART SA 400
with attractive metal case with cutouts for Data Cable switch, fuse and power cord.
LOBO SA400-C **$325.00**

SHUGART SA400
with Cabinet and Power Supply. Assembled, tested & guaranteed
LOBO SA400-PSC **$395.00**

SHUGART 801R 8"
6.4 megabits, single or double density, hard or soft sector, write protect, and more
SHUGART 801R **$449.00**

Siemens FDD 200-8 8" double-sided double density
$650.00

DISC CONTROLLER

SD "VERSAFLOPPY" Kit
The Versatile Floppy Disk Controller **Only $159.00**



FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:
1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy.
3. PERSCI 70 and 277.
4. MFE 700/750.
5. CDC 9404/9406.
6. GSI/Siemans FDD120-8.

34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Comptier. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives, Both Mini and Full Size. FD1771B-1 Single Density Controller Chip. Listings for Control Software are included in price.

CPM for SD Versafloppy **$100.00**

DUAL SHUGART DISC DRIVES

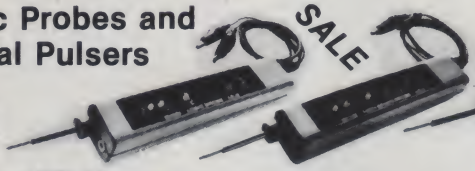
New from Lobo Drives, a dual Cabinet complete with power suppiy, and Shugart 801R disc drives.

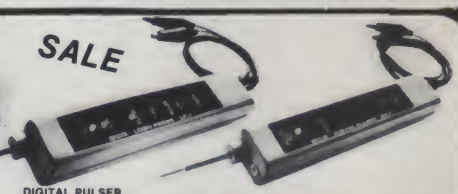
- Cabinet accepts 2 801R drives mounted side by side horizontaliy.
- Power Supply for 2 drives
- Ad-on drives available
- Assembied, tested and guaranteed by Lobo Drives.
- Single or double density • Hard or soft sector • Write Protect
- Capacity: Unformatted single density 3.2 megabits
  double density 6.4 megabits
  IBM format, 2 megabits
- 500 KBS transfer, 77 tracks.
- Shugart 800 Series Compatible

LOBO 801R-1 Pcs. Dual Cabinet with 1 drive **$599.00**
LOBO 801R-2 Pcs. Dual Cabinet with 2 drives **$1025.00**
SHUGART 801R Ad-on disc drive **$449.00**

CONTINENTAL SPECIALTIES CORPORATION

CSC Logic Probes and Digital Pulsers





LOGIC PROBES

CSC logic probes are the ultimate tool for breadboard design and testing. These hand-held units provide an instant overview of circuit conditions. Simple to use; just clip power leads to circuit's power supply, set logic family switch to TTL/DTL or CMOS/HTL. Touch probe to test node. Trace logic levels and pulses through digital circuits. Even stretch and latch for easy pulse detection. Instant recognition of high, low or invalid levels, open circuits and nodes. Simple, dual-level detector LEDs tell it quickly, correctly. HI (Logic "1"); LO (Logic "0"). Also incorporates blinking pulse detector. e.g., HI and LO LEDs blink on or off, tracking "1" or "0" states at square wave frequencies up to 1.5 MHz. Pulse LED blinks on for ½ second during pulse transition. Choice of three models to meet individual requirements; budget, project and speed of logic circuits.

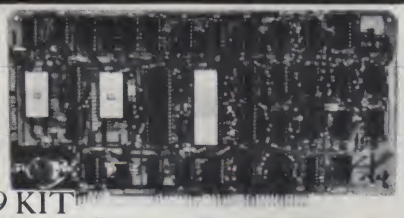
MODEL LP-1
Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL or CMOS. **Input Impedance:** 100,000 ohms. **Minimum Detectable Pulse:** 50 ns. **Maximum Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.
CSC Model LP-1 Logic Probe—Net Each ..... ~~$44.95~~ **$42.70**

MODEL LP-2
Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. **Input Impedance:** 300,000 ohms. **Minimum Detectable Pulse:** 300 ns. **Maximum Input Signal (Frequency):** 1.5 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** None.
CSC Model LP-2 Logic Probe—Net Each ..... ~~$24.95~~ **$23.70**

MODEL LP-3
High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 ohms. **Minimum Detectable Pulse:** 10 ns. **Maximum Input Signal (Frequency):** 50 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.
CSC Model LP-3 Logic Probe—Net Each ..... ~~$69.95~~ **$66.45**

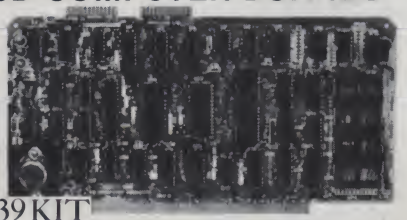
DIGITAL PULSER
The ultimate in speed and ease of operation. Simply connect clip leads to positive and negative power, then touch DP-1's probe to a circuit node; automatic polarity sensor detects circuit's high or low condition. Depress the pushbutton and trigger an opposite polarity pulse into the circuit. Fast troubleshooting includes injecting signals at key points in TTL, DTL, CMOS or other popular circuits. Test with single pulse or 100 pulses per second via built-in dual control push-button; button selects single shot or continuous modes. LED indicator monitors operating modes by flashing once for single pulse or continuously for a pulse train. Completely automatic, pencil-size lab/field pulse generator for any family of digital circuits. **Output:** Tri-state. **Polarity:** Pulse-sensing auto-polarity. **Sync and Source:** 100 mA. **Pulse Train:** 100 pps. **LED Indicator:** Flashes for single pulse; stays lit for pulse train.
CSC Model DP-1 Digital Pulser—Net Each ..... ~~$74.95~~ **$71.20**

SD COMPUTER BOARDS



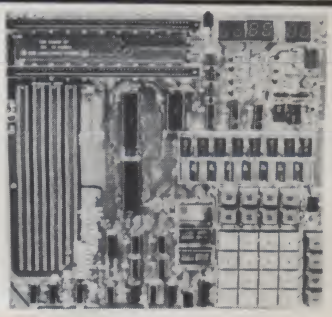
$319 KIT
VDB-8024 Video Display Board
With On-Board Z80 Microprocessor

- Full 80 Characters by 24 lines display
- Characters displayed by High Resolution 7 × 10 Matrix
- Keyboard Power and Interface
- Composite Video Output
- Separate TTL Level Synchronization and Video Outputs
- 2K Bytes Independent On Board Memory
- On-Board Z80 Microprocessor
- Glitch Free Display
- 96 Upper and Lower Case Characters
- 32 Special Character Set
- 128 Additional user Programmable Characters
- Full Cursor Control
- Forward and Reverse Scrolling Capability
- Operates as an Independent Terminal
- Variable Speed Display Rate
- Blinking, Underlining, Field Reverse, Field Protect and Combinations



$239 KIT
SBC-100 Single Board Computer
with On-board RAM, PROM, CTC

- Four Channel Counter/Timer (Z80-CTC)
- Software Programmable Baud Rate Generator
- S-100 Bus Compatible
- No Front Panel Required for Operation
- Optional Vectored Interrupts
- Z80Central Processing Unit
- 1024 Bytes of Random Access Memory
- 8K Bytes of Available PROM
- Serial Input/Output Port with both Synchronous and Asynchronous Operation
- Parallel Input and Output Ports



$249
Z80 Starter Kit
A Complete Microcomputer on a Board

- Z80 Central Processing Unit with 158 Instructions
- On Board Keyboard and Display
- Kansas City Standard Cassette Interface
- PROM Programmer Built on-board
- Expansion provision for two S-100 Connectors
- Wire Wrap area for custom circuitry
- Single 5 Volt Operation when not programming
- 1K Bytes of RAM (Expandable to 2K Bytes)
- 1K Bytes of RAM (Expandable to 2K Bytes)
- 4 Channel Hardware Counter/Timer (Z80-CTC)
- Two Bi-directional 8-bit I/O Ports (Z80-PIO)
- Switch Selectable PROM or Monitor Restart
- 2K Byte ZBUG Monitor in ROM
- Memory Examine and Change
- Port Examine and Change
- Z80 CPU Register Examine and Change
- Up to 5 Programmable Breakpoints
- Single Step through RAM or PROM
- Audio Cassette Load and Dump
- Vectored Interrupts provided by Z80-CTC and Z80-PIO
- Ideal for Experimentation and Evaluating the Z80 CPU

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HICKOK LX303 $74.95

HICKOK LX303 $74.95*



.5%, 3½ digit 19 Range DVM. ½" LCD displays runs 200 hrs on 1 battery. 10 Meg Ohm Input. 1 yr. guarantee, made in U.S.A., test leads included.

Available Accessories

- **RC-3** 115V AC Adapter **$7.50**
- **CC-3** Deluxe Padded Vinyl Carrying Case **$7.50**
- **VP-10** X10 DCV Probe Adapter/ Protector 10Kv **$14.95**
- **VP-40** 40Kv DC Probe **$35.00**
- **CS-1** 10 Amp Current Shunt **$14.95**

***FREE**

Just for Asking.
FREE BATTERY with your meter.

RS232 & "D" TYPE CONNECTORS

P = Plug-Male S = Socket-Female C = Cover-Hood

PART NO.	DESCRIPTION	PRICE 1-4	5-9	10-24
DE-9P	9 Pin Male	1.50	1.30	1.20
DE-9S	9 Pin Female	2.15	2.05	1.95
DE-9C	9 Pin Cover	1.50	1.30	1.15
DA15P	15 Pin Male	2.20	2.00	1.80
DA15S	15 Pin Female	3.20	3.00	2.80
DA15C	15 Pin Cover	1.60	1.45	1.30
DB-25P	**25 Pin Male**	**2.90**	**2.60**	**2.50**
DB-25S	**25 Pin Female**	**3.75**	**3.65**	**3.40**
DB51212-1	**1 pc. Grey Hood**	**1.65**	**1.40**	**1.20**
DB1226-1A	**2 pc. Black Hood**	**1.90**	**1.80**	**1.50**
DB110963-3	**2 pc. Grey Hood**	**1.60**	**1.55**	**1.35**
DC37P	37 Pin Male	3.95	3.80	3.60
DC37S	37 Pin Female	5.75	5.50	5.20
DC37C	37 Pin Cover	2.20	1.95	1.75
DD50P	50 Pin Male	4.95	4.75	4.50
DD50S	50 Pin Female	7.50	7.20	6.90
DD50C	50 Pin Cover	2.50	2.20	2.10
D20418-S	Hardware Set (2 pair)	1.00	.80	.70

MALE / FEMALE

Connector for CENTRONICS 700 SERIES:
Amphenol 57-30360 for back of Centronics 700 Series printers
1-4—$9.00 5-up—$7.50

3 LEVEL GOLD WIRE WRAP SOCKETS

Sockets purchased in multiples of 50 per type may be combined for best price.

	1-9	10-24	25-99	100-249	250-999
8 pin	.40	.36	.34	.31	.27
14 pin	.39	.38	.36	.32	.31
16 pin	.50	.42	.40	.36	.34
18 pin	.70	.60	.55	.50	.45
20 pin	.90	.80	.75	.65	.62
22 pin	.95	.85	.80	.70	.65
24 pin	.95	.85	.80	.70	.65
26 pin	1.25	1.15	1.00	.95	.90
40 pin	1.65	1.45	1.35	1.20	1.10

All sockets are GOLD 3 level closed entry. 2 level Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION.

SALE S-100 BUS EDGE CONNECTORS SALE

S100-WWG 50/100 Cont. .125 ctrs. 3 LEVEL WIRE WRAP .025" sq. posts on .250 spaced rows. GOLD PLATED.
1-4 $4.00 | 5-9 $3.75 | 10-24 $3.50

S100-STG 50/100 Cont. .125 ctrs. DIP SOLDER TAIL on .250 spaced rows for VECTOR, IMSAI, CROMENCO mother boards GOLD plated.
1-4 $3.50 | 5-9 $3.25 | 10-24 $3.00

S100ALT 50/100 Cont. .125 ctrs. DIP SOLDER TAIL on .140 spaced rows for ALTAIR motherboards. GOLD plated.
1-4 $4.50 | 5-9 $4.25 | 10-24 $4.00

S100SE 50/100 Cont. .125 ctrs. PIERCED SOLDER EYELET tails. GOLD
1-4 $5.00 | 5-9 $4.50 | 10-24 $4.00

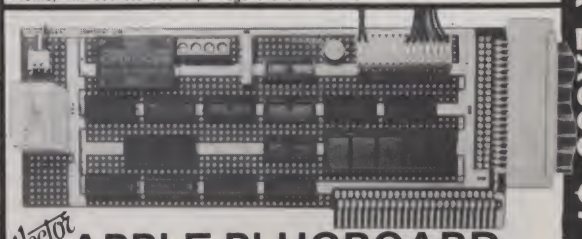
Other Popular Edge Connectors

D2244-5SE 22/44 Cont. .156 ctrs. PIERCED SOLDER EYELET tails. GOLD plated.
1-4 $3.00 | 5-9 $2.60 | 10-24 $2.20

D2244-5WW 22/44 Cont. .156 ctrs. WIRE WRAP tails. GOLD.
1-4 $3.95 | 5-9 $3.70 | 10-24 $3.40

CG-1 IMSAI Style Card Guides 5/$1.00

See our July Ad for many other connectors.



Vector

APPLE PLUGBOARD

Vector 4609 Peripheral Interface Plugboard for construction of custom circuits. Plug compatible with Apple II, Commodore PET and Super Kim microcomputers. Three connectors, in addition to the standard 25/50 system bus, are available for input/output. A 20/40-contact card-edge connector, fabricated on the rear of the board, mates with a 3-M type ribbon connector. Alternatively, a right-angle solder-tail header may be positioned in this same location. The Model 4609 also accomodates the miniature SIP-type connectors which may be placed on the periphery or in mid-board.

1-4 **$19.95** | 5-9 **$17.96** | 10-24 **$15.96**

- Kit includes 12 tantalum capacitors for +5, +12, −12 buses and insulated mounting spacers
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper solder plated and .038 diameter holes for leads
- Solder mask with solder windows on etched circuits to avoid accidental short circuits
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R&R-2, or mounts 10 receptacles plus interconnections to smaller mother board for expansion
- Includes etched circuits and instructions for option of active pull-up, or floating terminations
- Large buses +5V and GND (10 AMPS). ±12V or 16V (7 AMPS). Current ratings are per MIL STD 275 with 10°C rise
- Fits in Vector pak enclosures
- Fits in IMSAI 8080 microcomputer as expander board

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Vector



Price: $29.50

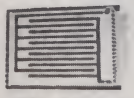


Vector

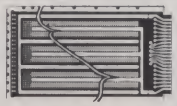
Plugboards

8800V
Universal Microcomputer/processor plugboard. use with S-100 bus. Complete with heat sink & hardware 5 3" x 10" x 1/16
1-4 $19.95 | 5-9 $17.95 | 10-24 $15.96

8801-1
Same as 8800V except plain. less power buses & heat sink
1-4 $15.22 | 5-9 $13.79 | 10-24 $12.18



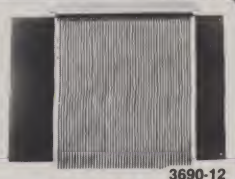
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3682-2 6.5" x 4.5" **$9.81**
Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



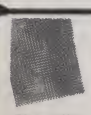
3677 9 6" x 4.5' **$10.90**
3677-2 6.5" x 4.5" **$9.74**
Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156



3662 6.5" x 4.5" **$7.65**
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Card Extender has 100 contacts 50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems. **$25.83**
3690 6.5" 22/44 pin .156 ctrs. Extenders $13.17



1/16 Vector BOARD .042 dia holes on 0.1 spacing for IC's

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84P44	4.5x8.5"	$2.21	$1.99
169P44	4.5x17"	$4.52	$4.07
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4116's RAMS
from Leading Manufacturers
(16Kx1 200ns)

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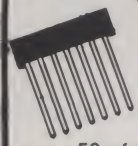
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for .042 dia. holes
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Bare Board w/all parts less mem. 99.95

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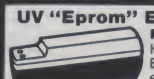
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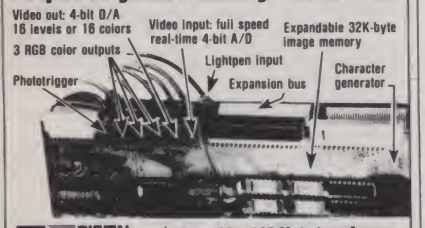
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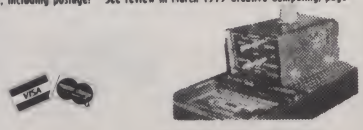
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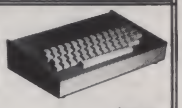
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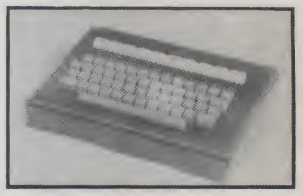
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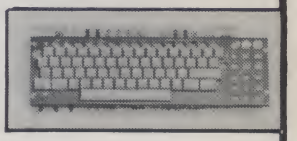
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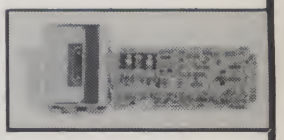


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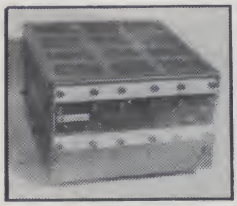
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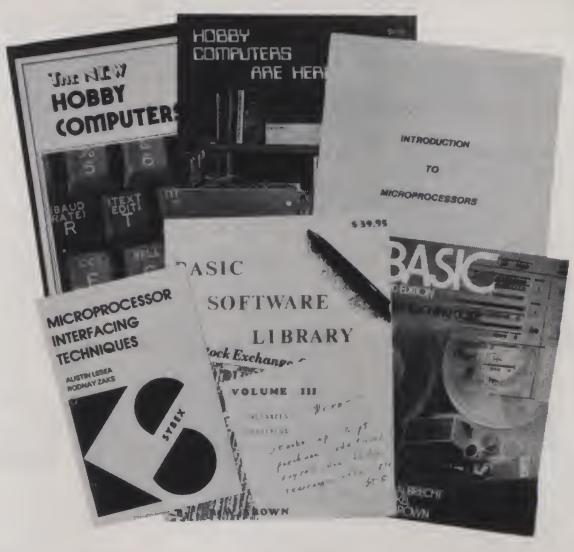
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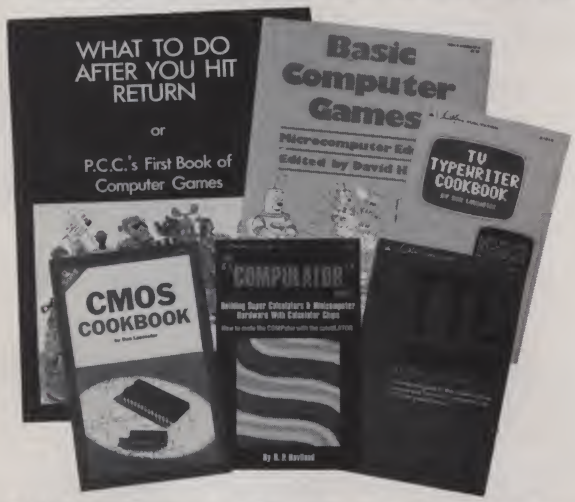
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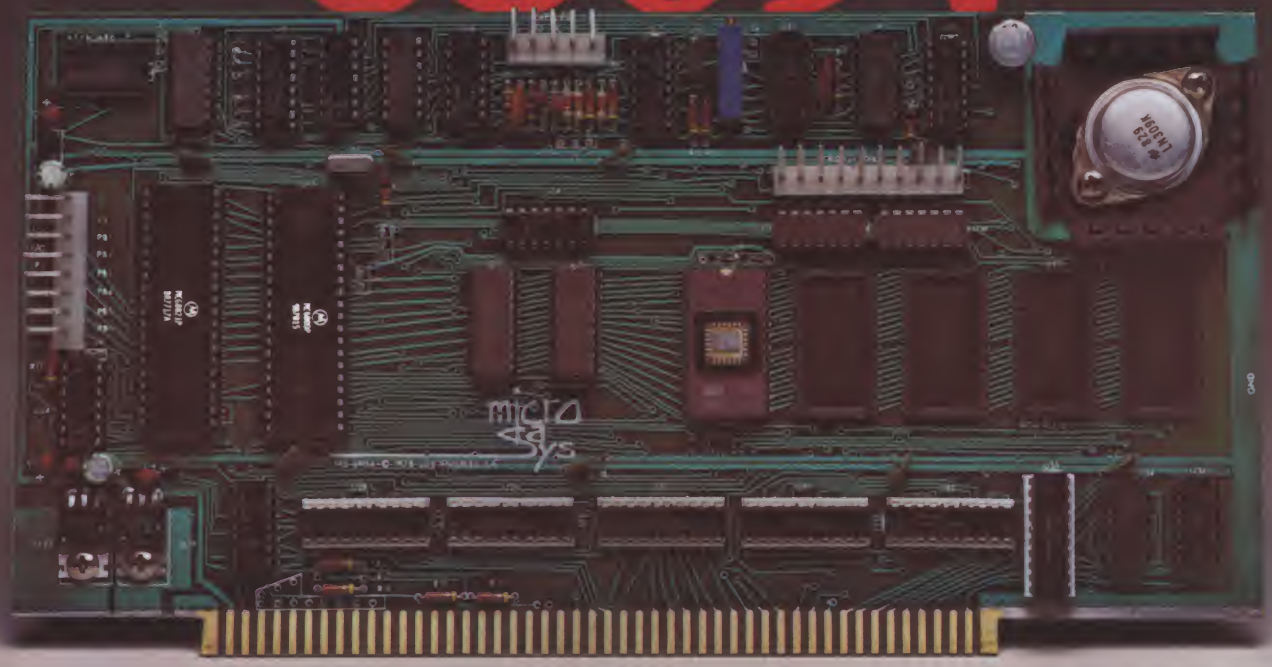
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